IMPORTANCE OF SAFETY IN CONSTRUCTION For any construction activity to begin, the first and the foremost thing to be given importance is the Safety in Construction. The contractor shall employ only such methods of construction, tools and plant as are appropriate for the type of work or as approved by Executive Engineer. The contractor shall take all precautions and measures to ensure safety of works and workman and shall be fully responsible for the same. Safety pertaining to construction works such as excavation, centering and shuttering, trenching, blasting, demolition, electric connections, scaffolds, ladders, working platforms, gangway, mixing of bituminous materials, electric and gas welding, use of hoisting and construction machinery shall be governed by safety code, relevant safety codes and as per the direction of Executive Engineer.

# TECHNICAL SPECIFICATIONS FOR

# Materials

**General**

This specification establishes and defines the requirement of various materials to be used in Civil and Structural works for the materials or items listed or detailed in the Technical bid or in scope or in the specifications only to be used .

**1.0 General**

1.1 This specification establishes and defines the requirement of various materials to be used in Civil and Structural works.

1.2 Whenever any reference to IS Code is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the bid.

1.3 Apart from the IS Codes mentioned in particular in the various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/or inspection procedures shall be applicable. Reference to some of the Codes in the various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.

1.4 In case any variation / contradiction between the provision of IS Codes and this specification, the provision given in this specification shall be followed.

1.5 All materials shall be of standard quality and shall be procured from renowned sources / manufactures approved by the Engineer. It shall be the responsibility of the Tenderer, to get all materials / manufactures approved by the Engineer prior to procurement and placement of order.

1.6 Whenever called for by the Engineer, tests of all materials as specified by the relevant IS Codes shall be carried out by the Tenderer in an approved laboratory and test reports duly authenticated by the laboratory, shall be submitted to the Engineer for his approval. If so desired by the Engineer, tests shall be conducted in the presence of the Engineer or his authorised nominee.

1.7 Quality and acceptability of materials not covered under this specification shall be governed by the relevant IS codes. In case IS code is not available for the particular material, manufactures specifications shall be considered. The decision of the Engineer, in this regard, shall be final and binding on the Tenderer.

1.8 Whenever asked for, the Tenderer shall submit representative samples of materials to the Engineer for his inspection and approval. Approval of any sample does not

necessarily exempt the Tenderer from submitting necessary test reports for the approved material, as per the specification / relevant IS Codes.

1.9 The Tenderer shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application, workmanship, etc. for the intended use. Submission of manufacturer's test reports does not restrict the Engineer from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacture / source at any stage of execution of work.

1.10 All costs relating to or arising our of carrying out the test and submission of test reports and or samples to the Engineer for his approval during the entire tenure of the work shall be borne by the Tenderer and included in the quoted rates.

1.11 Materials for approval shall be separately stored and marked, as directed by the Engineer and shall not be used in the works till these are approved.

1.12 All rejected materials shall be immediately removed from the site by the Tenderer at his own cost.

## 2.0 Materials

### 2.1 Water

2.1.1 Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalis, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water samples shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of the Engineer, if it meets all the requirements of IS:456.

2.1.2 Tests on water samples shall be carried out in accordance with IS: 3025 and they shall fulfill all the guidelines and requirements given in IS: 456.

2.1.3 The Engineer may require the Tenderer to prove, that the concrete prepared with water, proposed to be used, shall not have average 28 days compressive strength lower than 95% of the strength of concrete prepared with distilled water.

2.1.4 The Engineer may require the Tenderer to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil / organic matter or an excess of acid, alkalis or any injurious amount of salts etc., beyond the permissible maximum limits given in IS:456, the Engineer may refuse to permit its use. In case the water is supplied by BDA, the Tenderer shall get himself satisfied regarding its quality before using the same in his works at his own expenses. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements. The water test must be conducted periodically at least once in 3 months or as directed by Engineer.

2.1.5 Water shall be stored in tin barrels, steel tanks or water – tight reservoirs made with bricks / stone or reinforced concrete. Bricks / stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs must be of sufficient capacity to meet the water requirement, at any stage of construction.

2.1.6 Water for curing shall be of same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain / reinforced concrete and masonry works. Sea water shall not be used for hydro testing and checking the leakage of liquid retaining structures also.

### 2.2 Aggregate

#### 2.2.1 General

2.2.1.1 Coarse and fine aggregates for Civil and Structural works shall conform in all respects to IS:383 (Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall be obtained from an approved source known to produce the same satisfactorily. Aggregates shall consist of naturally occurring (crushed or uncrushed)

stones, gravel and sand or a combination thereof. These shall be chemically inert, hard, strong, dense durable, clean and free from veins, adherent coatings, injurious amount of alkalis, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells, etc.

2.2.1.2 Source and type of aggregates shall be got approved by the Engineer prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer can allow a change in source and type of aggregate. The Tenderer shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix design for approval of the Engineer. Any such change, if permitted by the Engineer, shall be without any time and cost implication to BDA. Whenever there is any change in the source of material, and if the material is approved by Engineer with necessary test certificates from approved laboratory, mix design of concrete shall also be revised and approved. The concrete so approved should have the required workability with new source of materials and also the characteristic strength of the concrete. All design mixes must be as per IS: 456 – 2000

2.2.1.3 Aggregates which may chemically react with alkalis of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Engineer, the Tenderer shall carry out alkali reactivity tests and submit the results to him for approval.

2.2.1.4 The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS: 2386 – Part II (Method of Test for aggregates for concrete), shall not exceed the limits defined in IS: 383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the Tenderer shall submit necessary test results as per IS: 383 and IS: 2386 to the Engineer prior to his acceptance with the requirements given in IS: 2430

2.2.1.5 Coarse and fine aggregates shall be batched separately. All – in – aggregate shall be used only where specifically permitted by the Engineer. Separate sieve analysis and grading curves shall be prepared by the Tenderer for any / all batches of coarse and fine aggregates, and submitted to the Engineer, whenever asked for, to ensure conformity with those submitted along with the mix design.

2.2.1.6 Whenever required by Engineer, the aggregate (coarse / fine) shall be washed and / or sieved by the Tenderer before use in the works to obtain clean and graded aggregate at no extra cost to BDA.

2.2.1.7 Aggregates not in conformity with the specifications shall be rejected and the Tenderer shall immediately remove them from the site of work.

### 2.2.2 Coarse Aggregate

2.2.2.1 Coarse aggregates are the aggregates, which are retained on 4.75mm IS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).

2.2.2.2 These may be obtained from crushed or uncrushed gravel or stone as per Clause 2.2.1 and may be supplied as single sized or graded. The grading of the aggregates shall be as per IS: 383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the Tenderer shall submit to the Engineer at least three sets of mix design and test results, each with different grading of coarse aggregates, proposed to be used. The Engineer may allow "All – in – Aggregates" to be used provided they satisfy the requirements of IS: 383.

### 2.2.3 Fine Aggregate

2.2.3.1 Fine aggregates are the aggregates which pass through 4.75mm IS sieve but not more than ten percent (10%) pass through 150 micron IS sieve. These shall comply with the requirements of grading zones I, II and III of IS: 383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.

2.2.3.2 Fine aggregates shall consist of material resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or gravel sand. Sand from sea shores, creeks or river banks affected by tides, shall not be used for filling or concrete works.

**2.2.4 Sampling and Testing**

The Tenderer shall carry out all tests including mix designs of concrete, at his own expense, at the start of works as well as during any stage of construction as required by the Engineer. Test shall be carried out in accordance with IS: 516 – Methods of test for strength of concrete and IS: 2386 – Methods of test for aggregates for concrete. Testing shall be carried out from laboratories approved by the Engineer. The method of sampling shall be in accordance with the requirements given in IS: 2430.

**2.2.5 Storage of Aggregate**

2.2.5.1 Storage of all types of aggregates at site of works shall be at Tenderer's expense and risk and shall be stored as specified in IS:4082. Aggregates shall in no case be stored near to the excavated earth or directly over ground surface.

2.2.5.2 The Tenderer shall maintain sufficient quantities of aggregates, near to the place of work, required for the continuity of the work. Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope of drainage of water.

2.2.5.3 Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for at least 24 hours. The Tenderer shall obtain prior approval of the Engineer for the use of such aggregates and shall adjust the water content in accordance with IS: 2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content, the Tenderer can make suitable adjustment in the masses as per IS: 456, for preparation of nominal mix concrete only.

**2.3 Sand**

**2.3.1 Sand for Masonry Mortar**

2.3.1.1 The sand shall consist of natural sand, crushed stone and or crushed gravel sand or a combination of any of these. The sand shall be hard durable, clean and free from adherent coatings and organic matter and shall not contain clay, silt and fine dust more than the amount specified in IS: 2116.

2.3.1.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening strength or durability of the mortar.

2.3.1.3 Unless found satisfactory as a result of further tests as may be specified by the Engineer, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand when tested in accordance with IS:2386, shall not be more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS: 2386 colour of the liquid shall be lighter than that indicated by the standard solution specified in IS: 2386.

**2.3.2 Grading of sand**

The particle size grading of sand for use in mortars shall be within the limits as specified below:

**GRADING OF SAND FOR USE IN MANSONRY MORTARS**

| IS SIEVE DESIGNATION | PERCENTAGE (%) PASSING BY MASS | REF TO METHOD OF |
|---|---|---|

| | | |
|---|---|---|
| IS : 460 (PART I) | | |
| 4.75 mm | 100 | IS : 2386 (Part I) |
| 2.36 mm | 90 to 100 | |
| 1.18 mm | 70 to 100 | |
| 600 micron | 40 to 100 | |
| 300 micron | 5 to 70 | |
| 150 micron | 0 to 15 | |

In case of sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and / or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand may be considered by the Engineer. The various sizes of particles of which the sand is composed shall be uniformly distributed the mass.

### 2.3.3 Sampling and Testing

The method of sampling shall be in accordance with IS: 2430. The amount of material required for each test shall be as specified in relevant parts of IS: 2386. Any test which the Engineer may require in connection with this, shall be carried out in accordance with the relevant parts of IS: 2386

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS: 2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

### 2.3.4 Sand for Filling

Sand for filling shall meet, the requirements IS: 383 and shall be natural sand, hard, strong, free from any organic and deleterious materials. Any sand proposed for filling, shall be used only after it is approved by the Engineer. Sand obtained from sea shores, creeks or river banks affected by tides, shall not be used for filling. Fine aggregate suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS-383 shall be allowed for filling.

## 2.4 Cement

Cement to be used for civil and structural works, shall be one of the following or in combination thereof. For plain and reinforced concrete works normally 43 grade ordinary portland cement conforming to IS: 8112, shall be used. Specific requirement for any other type of cement shall be as shown in the drawings or as specified in contract or as directed by Engineer. All masonry and plaster work shall be with PPC or other blended cement as approved by Engineer.

| | |
|---|---|
| Specification for grade ordinary portland cement | IS: 8112 |
| Specification for portland slag cement | IS: 455 |
| Specification for portland pozzolana cement | IS: 1489 |
| Specification for Masonry cement | IS: 3466 |
| Specification for high alumina cement for structural use | IS: 6452 |
| Specification for super sulphate cement | IS: 6909 |
| Specification for rapid hardening portland cement | IS: 8041 |
| Specification for 43 grade ordinary portland cement | IS: 8112 |

| | |
|---|---|
| Specification for 53 grade ordinary portland cement | IS: 12269 |
| Specification for Sulphate Resisting Portland cement | IS: 12330 |

**2.4.1 Storage at Site**

2.4.1.1 The storage of cement at the site of work shall be at Tenderer's expense and risk and shall meet the requirements of IS: 4082. The cement shall be stored above ground in a suitable weather tight buildings or godown and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture. Apart form this, the cement so stacked should be replaced once in three months, top bag to bottom row and bottom to top to avoid clotting. Such cement in long stored condition shall be retested for properties.

2.4.1.2 All approved cement shall be arranged in batches with type, brand and date of receipt flagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer. The Tenderer shall maintain a register on day to day basis, giving the details of the receipt / consumption, source of supply and type of cement, etc. The register shall always be accessible to the Engineer for verification.

**2.4.2 Test after Delivery**

Each consignment of cement procured by Tenderer, shall after delivery at site and at the discretion of the Engineer, be subjected to any or all of the tests and analyses, required by the relevant Indian Standard Codes. The Tenderer shall carry out and bear the cost of all tests and analyses required to ensure quality of cement before using in actual works.

**2.4.3 Rejection**

The Engineer may reject at his discretion any cement, which has deteriorated owing to inadequate protection from moisture or due to induction of foreign matter or any other cause. Any cement which is considered defective, shall not be used and shall be promptly removed from the site by the Tenderer.

**2.5 Lime**

Lime shall be stone lime and conform to the specification Building Limes – IS : 712, Lime putty may be prepared from hydrated lime or quicklime. Hydrated lime shall be mixed with water to form a putty and stored with reasonable care to prevent evaporation for at least 24 hours before use.

Quick lime shall be slaked with enough water to make a cream, passed through a No. 10 sieve and then stored with reasonable care to prevent evaporation for at least 7 days before use. Quick lime or hydrated lime as instructed by the Engineer shall be used for masonry work. Hydrated lime will be supplied as hydrated lime and used for structural purposes. Fat lime will also be supplied as quick lime or hydrated lime as instructed by the Engineer-in-charge and used for the finishing coat in plastering, white washing, etc. Field tests according to IS: 1624 shall be carried out from time to time to determine the soundness of lime.

**2.6 Neeru**

Shall be made of class 'C' lime (i.e., pure fat lime) as mentioned in IS: 712. It shall be slaked with fresh water and then sifted and reduced to a thick paste by grinding in a mill. Neeru thus prepared shall be kept moist until used and no more than what can be consumed in 15 days shall be prepared at a time.

**2.7 Surkhi**

Shall be made by grinding well burnt bricks, bricks bats, burnt clay balls etc. the quality shall conform to IS:1344.

Brick bats, etc. shall be ground in a mechanical disintegrator to a fine powder passing through IS Sieve, No.9 (2.36mm) with a residue not exceeding 10% by weight.
Surkhi for Lime Surkhi plaster shall be ground to fine powder in a mortar mill to pass through IS Sieve of 150 micron (No. 100).
Surkhi shall be stored in a weather – proof shed on a brick – paved platform.

**2.8 Steel**

**2.8.1 General**

All steel bars, sections, plates and other miscellaneous steel materials, etc. shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing, etc. for all materials covered under this section, shall conform to respective IS Standards.

**2.8.2 Reinforcement Bars**

Reinforcement bars, to be used for civil and structural works, shall be one of the following or in combination thereof. High strength Deformed Steel bars of grade Fe 415 conforming to IS: 1786 shall normally be used. Specific requirement for any other type of reinforcement bars shall be as shown in the drawings or as specified in Contract or as directed by the Engineer.

| | |
|---|---|
| Specification for mild steel and medium tensile bars and hard drawn steel wire for concrete reinforcement (grade I) | IS: 432 |
| Specification for hard drawn steel wire fabric for concrete reinforcement | IS: 1566 |
| Specification for plain hand drawn steel wire for prestressed concrete | IS: 1785 |
| Specification for high strength deformed steel bars and wires for concrete reinforcement | IS: 1786 |
| Steel for general structural purposes (Grade A) | IS: 2062 |
| Specification for high tensile steel bars used in prestressed concrete | IS: 2090 |
| Specification for indented wire for prestressed concrete | IS: 6003 |
| Specification for corrosion resistant steel | IS: 1786 |

**2.8.3 Structural Steel**

Structural steel to be used for general structural purposes shall be of grade A conforming to IS: 2062. Specific requirement for any other type of structural steel shall be as shown in drawings or as specified in the contract or as directed by the Engineer. Structural steel sections shall conform to following IS specifications.

| | |
|---|---|
| Steel tubes for structural purposes | IS: 1161 |
| Mild steel tubes, tubular and other wrought steel fittings | IS: 1239 |
| Steel for general structural purposes (Grade A) | IS: 2062 |
| Hollow steel sections for structural use | IS: 4923 |

**2.8.4 Miscellaneous Steel Materials**

Miscellaneous steel materials shall be conforming to the following IS Specification.

| | |
|---|---|
| Expanded metal steel sheets for general purposes | IS: 412 |

Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (grade I)
(For mild steel bars of anchor bolts, rungs, metal

| | |
|---|---|
| inserts, grating etc.) | IS: 432 |
| Hexagonal head bolts screws & nuts of product grade C | IS: 1363 |
| Cold formed light gauge structural steel sections | IS: 811 |
| Technical supply conditions for threaded steel fasteners | IS: 1367 |
| Plain washers | IS: 2016 |
| Steel wire ropes for general engineering purposes | IS: 2266 |
| Thimbles for wire ropes | IS: 2315 |
| Building grips | IS: 2361 |
| Mild steel tubes, tubular and other wrought steel filling (for hand rail tubular sections) | IS: 1239 |
| Drop forged sockets for wire ropes for general engineering purposes | IS: 2485 |
| Steel chequered plates | IS: 3502 |
| Hexagonal bolts and nuts (M42 to M150) | IS: 3138 |

**2.8.5 Steel Windows & Doors**

Steel windows and doors shall be fabricated out of steel sections as in IS: 226 and shall conform to IS: 1038. Unless otherwise specified the details of construction, etc. shall be as described under 'Specification'.

**2.9 Bricks**

Bricks shall subject to the following, generally comply with IS: 1077, the sizes, however, will be as locally available. Bricks shall be of the quality locally available, table moulded if so specified and if locally made, well burnt but not over burnt, have plane rectangular faces with parallel sides, and sharp, right angled edges, of compact and uniform texture, without cracks, chips, flaws stones and nodules. They shall not show efflorescence, either dry or subsequent to soaking in water and shall emit a clear ringing sound, on being struck and not absorb water more than 15% by weight. The bricks shall also have compressive strength not less than as stipulated in the item specifications .

Common clay burnt bricks of no stipulated compressive strength shall generally be as specified in the previous paragraphs but be only ground moulded, may be slightly distorted and have slightly rounded edges. They shall have a compact and uniform texture and shall not absorb water more than 15% by weight and shall have a minimum compressive strength of 35 kg / $cm^2$. The size of the bricks i.e., dimensions must be well within the tolerance allowed as per IS: 1077 – 1970.

**2.10 Stone**

**2.10.1 General**

All stones used for masonry works shall conform to the requirements of following IS Codes.

| | |
|---|---|
| Method of identification of natural buildings stones | IS: 1123 |
| Recommendations for dimensions and workmanship of natural building stones for masonry work | IS: 1127 |
| Recommendations for dressing of natural building stones | IS: 1129 |

**2.10.2 Quality of Stones**

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalis, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea, shells etc. Unless otherwise approved, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS: 1905, taking into account the

appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS: 1124, shall not exceed 5%.

Stones normally used, shall be small enough to be lifted and placed by hand. The length of the stone shall not exceed 3 times the height. Width of stone on base shall not be less than 150mm and in no case exceed 3/4th thickness of the wall. Height of the stone shall not be more than 300mm.

**2.10.3 Unloading / Stacking**

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS:4082 and shall be stacked on a firm ground having adequate slope for drainage. The supply of stones shall be so arranged that as far as possible at least two day's requirements of stone are available at site at any time.

**2.11 Admixtures**

**2.11.1 General Requirements for Admixtures**

2.11.1.1 All concrete admixtures shall in generally comply with the following Indian Standards unless otherwise stipulated in this specification

| | |
|---|---|
| Specification for integral cement water proofing compounds | IS: 2645 |
| Specification for other admixtures for concrete | IS: 9103 |

2.11.1.2 Generally admixtures shall have ISI certification marks. However, even in case of BIS certified admixtures, Engineer may require the Tenderer to carry out and submit any or all the tests (as specified in relevant IS Codes), from approved laboratories, over and above the manufacturer's certificate, before giving his final approval.

In case, admixtures certified by BIS are not available, the Tenderer shall submit to the Engineer the type and / or proprietary brand of the admixture from only reputed manufactures along with necessary test certificates from recognised and approved laboratories or any other document directed by Engineer for latter's final approval. In such cases, names of at least two manufacturers shall be submitted to the Engineer for his selection. In case both the names are rejected, the Tenderer shall submit a fresh list of two manufacturers for approval by the Engineer.

The Engineer may direct the Tenderer to submit test results as required by IS: 2645 or IS:9103 for any admixture proposed to be used in the concrete in any approved laboratory at his discretion at any stage of the work. The cost of any / all tests required to satisfy the compliance with the specifications shall be borne by the Tenderer.

2.11.1.3 Prior approval of the Engineer shall be obtained while using water reducing admixtures in the concrete (PCC / RCC) or mortar. Other type of admixtures such as accelerating admixtures, retarding admixtures or air entraining admixtures, shall not be used unless specified on the design drawings or prior approval taken from the Head office. Once approved, utmost care shall be exercised at site by the Tenderer to maintain the consistency in the quality if admixture and the concrete / mortar so produced.

2.11.1.4 The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates together with any other materials to be actually used in the works as per the direction of Engineer, if two or more admixtures are to be used.

Simultaneously in the same concrete mix, the Tenderer must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any / all tests specified in IS Codes shall be carried out only with the type of material and mix design, to be actually; used in the work site.

2.11.1.5 No admixture shall impair the durability of the concrete nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixture shall not reduce the dry density of concrete. Once the

proportion of admixture has been established, strict check shall be maintained not to alter the proportions of ingredients and water cement ratio of the design Mix during execution

2.11.1.6 The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement.

2.11.1.7 Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.

**2.11.2 Water Proofing Compounds**

2.11.2.1 Water proofing Compounds shall be mixed with only ordinary Portland cement of grade 43, conforming to IS:269.

2.11.2.2 The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.

2.11.2.3 The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS: 4031.

2.11.2.4 Compressive strength of specimen at 3 days shall not be less than 160 kg / sqcm. nor 80% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 220 kg / sqcm. nor less than 80% of the 7 days compressive strength prepared with the same cement and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS: 4031.

**2.12 Water Bars (Water Stops)**

**PVC Water bars shall be used in reinforced concrete**

Construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading, shrinkage or differential movement of foundations. Wherever desired or shown in the drawings, they shall be used at expansion / construction joints. These shall be performed and shall provide a permanent water tight seal along the entire joint in the poured concrete structures. These should also be flexible enough to withstand deflection / displacements at joints arising due to variation of temperatures or settlement of foundations. The minimum thickness of water bars shall be as shown on drawings or described in the schedule of rates and unless otherwise mentioned, these shall be able to withstand a water head of at least 12m.

2.12.1 Performance requirements of PVC water bars shall meet the requirements of IS: 12200. These shall be of approved make and of ribbed / serrated / plane type with a bulb at the centre. The thickness and width of water bars shall be as per schedule of rates / drawings but in no case the thickness shall be less than 5mm and width less than 150mm. The joining of the water bars shall be carried out by vulcanising strictly as per the manufacturer's specifications. Lapped joints shall not be allowed under any circumstances

**2.13 PVC Pipes**

PVC pipes shall conform to the requirements of IS: 4985.

**2.14 Wood / Timber**

2.14.1 Second class Indian Teak wood shall be conforming to IS: 4021 of good quality, well seasoned and free from defects such as cracks, dead knots, sapwood etc. No individual hard and sound knot shall be more than 15 sqcm. in size and the aggregate knot shall be more than 15 sqcm. in size and the aggregate area of such knots shall not exceed 2% of

the areas of the piece. The timber shall be fairly close grained having not less than 2 growth rings per cm. width in cross – section.

**2.14.2 Hard wood /Jack wood**

Hard wood shall be first class wood conforming to IS: 4021 of good quality, well seasoned and free from defects such as dead knots, cracks, sapwood etc. No individual hard and sound knot shall exceed 6 sqcm. in size with no dimension more than 50mm and the aggregate area of such knots shall not be more than 1% of the area of the place. There shall not be less than 5 growth rings per cm. width in cross – section.

2.14.2.1 Timber required to be used for form work shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the concrete. Storage of wood/timber shall be as per the requirement of IS:4082.

For proper identification and selection of suitable timber for form work, following codes shall be referred.

| | |
|---|---|
| Classification of commercial timbers and their Zonal distribution | IS: 399 |
| Specification for ballies for general purposes | IS: 3337 |
| Specification for plywood for concrete shuttering | IS: 4990 |

**2.14.3 Laminates**

The Laminates are thin sheets of plywood and polymer derivatives all pressed together to form thick boards of 3mm upwards. The laminates may also be glued / pressed on to block boards, particle boards etc depending on the production methods and end use.

The following IS standards shall be referred to for products

| | |
|---|---|
| Ply wood | IS: 303 |
| Marine plywood | IS: 710 |
| Decorative plywood | IS: 1328 |
| Flush doors | IS: 2046 |
| Laminates | IS: 2046 |
| Shuttering plywood | IS: 4996 |
| Laminates boards | IS: 12823 |

For the physical and mechanical properties of these products are covered by these codes. The property of resistance to surface wear, to dry heat, water, impact, cracking, steam, etc. be ascertained for the given applications.

For carpentry applications the manufactures instruction shall be followed in storage, handling, cutting, edge treatment and for use of appropriate tools.

**2.14.4 Treated Country Wood**

Treated wood shall be of best quality Padauk wood / Salwood chemically treated and KILN seasoned as stipulated in IS: 401 and IS: 1141 respectively with latest amendments. For the chemical treatment the following chemicals to be mixed with water in the proportion of 6:12:16 (i.e. Boric Acid / Copper Sulphate / Sodium Dichromate respectively). The moisture content of the wood after treatment and seasoning shall be in the range of 14 to 16%.

Before the wood work is fixed in position and earlier to application of primer, chloro pyrifos in a ratio of 1:20 (1 part of chemical and 20 parts of kerosene / turpentine) shall be applied in all faces as a wood preservative.

No individual hard and sound knot shall exceed 25 mm in dia and the aggregate area of such knots shall not be more than 1% of the area of the place. There shall not be less than 5 growth rings per cm. width in cross – sections.

**2.15 Floor Tiles**

Plain cement tiles, chequered tiles, mosaic tiles, terrazzo tiles shall conform to IS: 1237, compacted by mechanical vibration and hydraulically pressed, using grey cement for neutral shades. They shall be of choice shade and shall have the desired pattern of chip distributions. The sizes of chips and proportions of chips to cement in Terrazzo or mosaic floor shall be as specified in IS: 1237. The sizes and thickness of tiles shall be as specified in item Specification. The tiles shall be tested for abrasion, transverse strength, water absorption and thickness of wearing surface.

**Note**: Normally tiles shall be produced from an approved factory, but the Tenderer may manufacture them at the site itself with prior express permission in writing of the Engineer who will satisfy themselves as to the adequacy and competence of the arrangements proposed to be made (by the Tenderer) for the purpose the Engineer may refuse to give the permission / cancel the permission given if the proposed arrangements / arrangements made are not satisfactory

**2.15.1 Glazed Tiles**

White or coloured glazed tile shall comply with IS: 777. They shall be from an approved manufacturer and shall be flat and true to shape, they shall be free from cracks, crazing, spots, chipped edges and corners. The glazing and colour shall be of uniform shade and unless otherwise specified the tiles shall be of 5mm minimum thickness.

**2.15.2 Other Tiles**

Burnt clay tiles for terracing, roofing and flooring, ceramic tiles, unglazed, vitreous, acid resisting, etc. shall all conform to the relevant IS Codes.

**2.15.3 Marble Slabs**

Marble slabs for flooring, dado, veneering etc., shall be of the kind specified in the item such as white or pink Makrana, Chittor black, Bhanswada black, Jaisalmer yellow, Barado Green, Patiala (Pepsu) Grey, etc. Marble from which the slabs are made, shall be of selected quality, hard, sound, dense, and homogeneous in texture, free from cracks, decay, weathering and flaws. Before starting the work the Tenderer shall get the sample of marble approved by the Engineer .

The slabs shall be machine cut and machine polished Kotah / Shahabad / Cuddapah / Granite will be of selected quality, hard, sound, dense and of homogeneous texture, free from cracks, decay, weathering and flaws. Stone slabs shall be of uniform colour and as approved by the Engineer. They shall be machine cut and machine polished where so specified and shall conform to the required sizes. Thickness shall be as specified in the respective item specifications.

**2.15.4 Ceramic Tiles**

Tiles shall be of approved make and confirm to IS: 13630 / 1992 all parts. They shall be flat and true to shape and free from blisters, crazing, chips, welts, crawling or other imperfections detracting from their appearances. The tiles shall be square in shape and of nominal size 300 X 300mm. Thickness of tiles shall be 8mm. Permissible deviations in length, squareness, straightness of sides and surface flatness shall not be more than $\pm$ 0.5% and that is thickness of $\pm$ 5.0%. For other types of ceramic tiles manufacturers specifications may be referred.

**2.15.5 Granite Tiles**

Granite tiles shall be of approved shade and quality. They shall be of 10 to 23mm thick mirror polished and machine cut. The tiles to be used shall be as laid down in the drawing or as directed by the Engineer. The angles shall be right angles and all edges shall be straight and true.

**2.15.6 Kota stone / Shahabad / Cuddapah**

The slabs shall be of selected quality and shade, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flaws. These shall be machine cut to the requisite size and thickness and chisel dressed underside. The slabs shall have the top (exposed) face polished before being brought to site. Before starting the work, the Tenderer shall get the samples of slabs approved by the Engineer.

**2.15.7 Stone Cladding / Stone Veneering Work**

Stone lining using blocks / slabs upto 80 mm thick shall be treated as veneering work and lining of greater thickness as Masonry.

These when used for table tops and floors may be of specified surfaces of polished / rough / dressed.

Stone: Stone shall be of type specified. It shall be hard, sound, durable and tough, free from cracks decay and weathering and defects like cavities, cracks, flaws, sand holes, veins, patches of soft or loose materials, etc.

The stone shall be cut into slabs of required thickness along the planes parallel to the natural bed of stone.

**2.15.8 Dressing**

Every stone shall be cut to the required size and shape, so as to be free from waviness and to give truly vertical and horizontal joints. For the faces that are to remain exposed in the final position and the adjoining faces to a depth of 6mm shall be the fine chisel dressed so that when checked with 60cm straight edge, no point varies from it by more than 1mm. The top and bottom faces that are to form the bed joints shall be chisel dressed so that variation from 60cm straight edge at no point exceeds 3mm. Faces which are to form the vertical joints should be chisel dressed so that variation at any point with 60cm straight edge does not exceed 6 mm. All angles and edges that are to remain exposed in the final position shall be true, square and free form chippings. A sample of dressed stone shall be prepared for approval of Engineer before starting the work. It shall be kept at the work site as a sample after being approved. The dressed slabs shall be of the thickness as specified, with permissible tolerance at 2mm.

**2.15.9 Marble**

Marble shall be hard, sound, dense and homogeneous in texture with crystalline texture as far as possible. It shall generally be uniform in colour and free from strains, cracks, decay, and weathering. Marble with streaks from the nature where specified shall be acceptable.

Every slab shall be machine cut to the required size and shape, on all sides to the full depth so that a straight edge laid along the side of the stone shall be fully in contact with it. Laying of slabs shall be as for cladding described in 2.16.7 mechanical fastness for supplying vertical elements shall be employed as approved by the Engineer. All angles and edges of the marbles shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slabs shall be 20, to 25mm or as specified in the description of the item. Tolerance of ± 3% shall be allowed for the thickness. In respect of length and breath of slabs a tolerance of ± 2% shall be allowed. Sample of marble approved shall be kept at site with the Engineer.

**2.15.10 Stone Cladding**

**Kotah stone / Cuddapah / Granite**

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer.

The slabs shall have the top (exposed) face polished. Before being brought to site unless otherwise specified. The slabs shall conform to the size required. Before starting the work the Tenderer shall get the samples of slabs approved by the Engineer .

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. Rough surfaces may be specified for this cladding as designed. The sides (edges) shall be table rubbed with coarse sand or machine rubbed. All angles and edges of the slab be true, square and free from chippings. Fixing/laying of the slabs shall be as per other stone claddings.

**2.16 Fibre Reinforced Concrete (FRC) / Manhole Covers**

Materials used in the manufacture of these manhole covers are high grade concrete, reinforcing bars and steel fibers mixed with concrete. Strengths suggested are M30 or more. The frame for the cover may be in steel fixed over the base or a steel lined concrete block . FRC is generally manufactured as precast elements at a central factory under controlled conditions, using mechanical means of vibrations and / or pressure to consolidate the concrete.

Manufacturing process and test results shall be as indicated and guaranteed by the manufacturer. These covers, like in CI covers are designed for light medium or heavy duty.

The covers shall have hooking facilities for removal and replacing.

As in the case of CI man hole covers rates / costs are to be indicated and measured inclusive of the frame to remove the cover.

**2.17 Paint**

Primer coating of structural steel shall be ready mix paint of red oxide zinc chrome, conforming to IS: 2074.

Synthetic enamel to be used, for painting of structural steel, shall conform to IS: 2932.

Primer / Enamel shall be tested as per the requirements of IS: 101.

**2.18 Anti Termite Compounds**

Chloro pyrifos emulsifiable concentrates (1%) conforming to IS: 8944 shall be used for treatment of soil for protection of buildings against attack by subterranean termites.

ANTI-TERMITE TREATMENT Sub-terranean termites are responsible for most of the termite damage in buildings. Typically, they form nests or colonies underground. In the soil near ground level in a stump or other suitable piece of timber in a conical or dome shaped mound. The termites find access to the super-structure of the building either through the timber buried in the ground or by means of mud shelter tubes constructed over unprotected foundations. Termite control in existing as well as new building structures is very important as the damage likely to be caused by the termites to wooden members of building and other household article like furniture, clothing, stationery etc. is considerable. Anti-termite treatment can be either during the time of construction i.e. pre- constructional chemical treatment or after the building has been constructed i.e. treatment for existing building Prevention of the termite from reaching the super-structure of the building and its contents can be achieved by creating a chemical barrier between the ground, from where the termites come and other contents of the building which may form food for the termites. This is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide. Materials Chemicals: Any one of the following chemicals in water emulsion to achieve

the percentage concentration specified against each chemical shall be used: Chlorphriphos emulsifiable concentrate of 20% Lindane emulsifiable concentrate of 20% Anti-termite treatment chemical is available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the specified percentage of concentration, Chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemical with water in the required proportion to achieve the desired percentage of concentration. For example, to dilute chemical of 20% concentration. 19 parts of water shall be added to one part of chemical for achieving 1% concentration. Engineer -in-Charge shall procure the chemical of required concentration in sealed original containers directly from the reputed and authorized dealers, chemical shall be kept in the custody of the Engineer-in-Charge or his authorized representatives and issued for use to meet the day's requirements. Empty containers after washing and concentrated chemical left unused at the end of the day's work shall be returned to the Engineer-in-Charge or his authorized representative. Measurements: Concentrated chemical in sealed containers shall be measured in litres. Chemicals of different types and concentration shall be measured separately. Safety Precautions Chemical used for anti-termite treatment are insecticides with a persistent action and are highly poisonous. This chemical can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mists or swallowed. The containers having emulsifiable concentrates shall be clearly labelled and kept securely closed in stores so that children or pet cannot get at them. Storage and mixing of concentrates shall not be done near any fire source or flame. Persons using these chemical shall be warned that absorption though skin is the most likely source of accidental poisoning. Particular care shall be taken to prevent skin contact with concentrates and prolonged exposure to dilute emulsion shall also be avoided. After handling the concentrates or dilute emulsion. Workers shall wash themselves with soap and water and wear clean clothing, especially before eating. In the event of severe contamination, clothing shall be removed at once and the skin washed with soap and water. If chemical has splashed into the eyes, they shall be flushed with plenty of soap and water and immediate medical attention shall be sought. Treatment Once the termites have an ingress into the building, they keep on multiplying and destroy the wooden and cellulosic materials, and as such it becomes essential to take measures for protection against termites. Anti termite measures described below are necessary for the eradication and control of termites in existing building. To facilitate proper penetrations of chemical in to the surface to be treated, hand operated pressure pump shall be used. To have proper check for uniform penetration of chemical, graduated containers shall be used. Proper check should be kept so that the specified quantity of chemical is used for the required area during the operation. Chemical treatment for the eradication and control of sub-terranean termites in existing building shall be done as per IS 6313 (Part III). Treatment shall be got done only from the approved specialized agencies using the chemical procured directly by the Executive Engineer from reputed and authorized dealers. Treatment along outside of foundations: The soil in contact with the external wall of the building shall be treated with chemical emulsion at the rate of 7.5 L/m2 of vertical surface of the sub-structure to a depth of 300 mm. To facilitate this treatment, a shallow channel shall be excavated along and close to the wall face. The chemical emulsion shall be directed towards the wall at 1.75 L/m of the channel. Rodding with 12 mm diameter mild steel rods at 150 mm apart shall be done in the channel. If

necessary, for uniform dispersal of the chemical to 300 mm depth from the ground level. The balance chemical of 0.5 L/m shall then be used to treat the backfill earth as it is returned to the channel directing the spray towards the wall surface. If there is a concrete or masonry apron around the building, approximately 12 mm diameter holes shall be drilled as close as possible to the plinth wall about 300 mm apart, deep enough to reach the soil below and the chemical emulsion pumped into these holes to soak the soil below at the rate of 2.25 L/m. In soils which do not allow percolation of chemicals to desired depth, the uniform disposal of the chemical to a depth of 300 mm shall be obtained by suitably modifying the mode of treatment depending on site condition. In case of RCC foundations the soil (backfill) in contact with the column sides and plinth beams along with external perimeter of the building shall be treated with chemical emulsion at the rate of 7.5 L/m2. of the vertical surface of the structure. To facilitate this treatment, trenches shall be excavated equal to the width of the shovel exposing the sides of the column and plinth beams upto a depth of 300 mm or upto the bottom of the plinth beams, if this level is less than 300 mm. The chemical emulsion shall be sprayed on the backfill earth as it is returned into the trench directing the spray against the concrete surface of the beam or column as the case may be. Treatment of Soil under Floors : The points where the termites are likely to seek entry through the floor are the cracks at the following locations:  At the junction of the floor and walls as result of shrinkage of the concrete;  On the floor surface owing to construction defects;  At construction joints in a concrete floor, cracks in sections; and  Expansion joints in the floor. Chemical treatment shall be provided in the plinth area of ground floor of the structure, wherever such cracks are noticed by drilling 12 mm holes at the junction of floor and walls along the cracks on the floor and along the construction and expansion joints at the interval of 300 mm to reach the soil below. Chemical emulsion shall be squirted into these holes using a hand operated pressure pump to soak the soil below until refusal or upto a maximum of one litre per hole. The holes shall then be sealed properly with cement mortar 1:2 (1 cement: 2 coarse sand) finished to match the existing floors. The cement mortar applied shall be cured for at least 10 days as per instruction of Engineer-in-charge. Treatment of Voids in Masonry : The movement of termites through the masonry wall may be arrested by drilling holes in masonry wall at plilnth level and squirting chemical emulsions into the holes to soak the masonry. The holes shall be drilled at an angle of 45 degree from both sides of the plinth wall at 300 mm intervals and emulsion squirted through these holes to soak the masonry using a hand operated pump. This treatment shall also be extended to internal walls having foundations in the soil. Holes shall also be drilled at wall corners and where door and window frames are embedded in the masonry or floor at ground. Emulsion shall be squirted through the holes till refusal or to a maximum of one litre per hole. Care shall be taken to seal the holes after the treatment. Treatment at Points of Contact of Wood Work : The wood work which has already been damaged beyond repairs by termites shall be replaced. The new timber shall be dipped or liberally brushed at least twice with chemical in oil or kerosene. All existing wood work in the building which is in contact with the floor or walls and which is infested by termites, shall be treated by spraying at the points of contacts with the adjoining masonry with the chemical emulsion by drilling 6 mm holes at a downward angle of about 45 degree at junction of wood work and masonry and squirting chemical emulsion into these holes till refusal or to a maximum of half a litre per hole. The treated holes shall then be sealed Infested wood work in chaukhats, shelves,

joints, purlins and other items in contact with the floor or the walls shall be provided with protective treatment by drilling holes of about 3 mm diameter with a downward slant to the core of the wood work on the inconspicuous surface of the frame. These holes should be at least 150 mm centre to centre and should cover in entire frame work. Chemicals shall be liberally infused in these holes. If the wood is not protected by paint or varnish two coats of the chemicals shall be given on all the surfaces and crevices adjoining the masonry. Cement Mortar : Cement Mortar with fine and forced sand 1:1 to 1:6 is considered as material component in the SR. Cement consumption coefficients are appended separately

**2.19 Polysulphide Sealants**

All Polysulphide Sealants shall conform to IS: 12118 and be of approved make. Test conditions and requirements shall be as given in the above referred IS code.

**3.0 Storage, Test and Rejection**

**i. Storage**

The storage of all materials at site of work shall be at the Tenderer's expense and risk and shall be done as per the requirements given in IS: 4082. The Tenderer shall maintain the proper record of receipt / consumption. The records shall always be accessible to the Engineer for verification.

The reinforcement bars, structural steel sections and other miscellaneous steel materials etc, shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting and wrapping. In case of any damage occurring to the material on account of faulty storage or negligence by the Tenderer, same shall be borne by the Tenderer himself.

**ii. Test after Delivery**

Materials supplied by BDA or Tenderer, shall, after delivery at site and at the discretion of Engineer, be subjected to any or all of the tests, required by the relevant IS Codes. The Tenderer shall carry out and bear the cost of such tests.

**iii. Rejection**

The Engineer may reject at his discretion any material, not withstanding the manufacturer's certificate or failing to meet the requirements of relevant IS codes for testing of materials. He may similarly reject any material, which has deteriorated or corroded, etc. due to improper storage, handling or transport. Defective materials shall not be used and removed from the site by the Tenderer at his own expense.

# TECHNICAL SPECIFICATION
# FOR
# CLEARING OF SITE, EXCAVATION, EARTH FILLING AND LAND SCAPING

CHAPTER -1 : EARTH WORK EXCAVATION CLASSIFICATION OF SOILS The Earthwork shall be classified under the following categories and measured separately for each category: All kind of soils: Generally any strata, such as sand, gravel, loam, clay, mud, black cotton moorum, shingle, river or nallah bed boulders, siding of roads, paths and hard core, macadam surface of any description (water bound, grouted tarmac), lime concrete mud concrete and their mixtures which for excavation yields to application of picks, showels, jumper, sacrifiers, ripper and other manual digging implements. Ordinary rock: Generally any rock which can be excavated by splitting with crow bars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and un-reinforced cement concrete below ground level. If required light blasting may be resorted to for loosening the materials but this will not in any way entitle the material to be classified as 'Hard rock'. Hard rock: Generally any rock or boulder for the excavation of which blasting is required such as quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like. Hard rock (blasting prohibited): Hard rock requiring blasting but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, use of rock hammers and cutters or any other agreed method. As explained above, the various classifications of the Soil at site are to be excavated considering the following aspects by the departmental Engineers. Before the earthwork is started, the whole area where the work is to be done shall be cleared of grass, roots of trees and other organic matter. Site preparation shall consist of clearing grubbing and removal of any and all inappropriate materials. The excavation shall be carried out in accordance with the dimension shown on the sanctioned drawings. If the soil at the specified depth is found to be unsuitable, then it shall be dug to a depth at which a stratum of good hard soil is found as directed by the Quality control authorites. Besides digging the earth, the word excavation signifies the all the works related such as dressing of the sides, ramming of bottom, disposing of any soil not required out of site, and keeping the outer edge of excavation. Sides of the trenches shall be vertical and its bottom shall be perfectly levelled, both longitudinally and transversely. The Contractor shall dispose off all surplus excavated soil at his own cost as directed by the Executive Engineer. Materials deemed not necessary or appropriate for the project shall be removed at the time of excavation. No material excavated from foundation trenches, shall be placed nearer than 1m to the outer edge of the excavation. The excavation shall be carefully executed as per the dimensions and elevations on sanctioned drawing and the established 'Benchmark' at the site. The contractor accepts full responsibility to align the building and slabs in reference to these given elevations. If any of the excavation be taken below the specified levels, the Contractor shall fill such excavation at his own expense with concrete well rammed in position until it is brought up to the proper levels; filling in with excavated materials will not be allowed for this purpose. If foundations are made broader or longer than directed, the extra length and breadth shall be filled in after the foundations are built with earth rammed and compacted, at the Contractor's expense. If the excavation is in earth, the bottom of the trenches shall be sprinkled with sufficient water to bring the soil to its optimum moisture and compacted to meet stated percentage of compaction. Any excess digging or any patches of bad soils or hollows shall be removed by placing concrete or shall be subject to any other special treatment as per the decision of Executive Engineer. If the soil is soft, loose or slushy the trench shall be widened for allowing steps on either sides or the sides sloped or shored up. During excavation if rocks or rocky soils are found, (if approved as suitable for foundation), those shall be leveled as far as possible and the small spaces which are difficult to level shall be filled in with CLSM. Water in trenches must be bailed or

pumped out and where it is apprehended that the sides may slip down arrangements shall be made for adequate shoring. The Contractor shall at his own expense, make provision for all extra excavation in slope, pumping, dredging or bailing out water from the trenches and keep free of water during the laying of foundation works. When it is specified that the work is to be carried out without removing pipes, cables, sewers etc. all of them shall be temporarily shored and saved from any damage. The materials or valuables found during excavation shall be the property of the Public Works Department, Government of Karnataka. The cost of all materials and labour required for fencing in and protection against risk of accidents due to open excavation shall be borne by the contractor. Care shall be taken in the disposal of water from the excavation to limit any damage to existing infrastructures or adjoining properties. The Contractor shall also at his own cost remove such portions of boulders or rocks and the remains of the old dismantled structures as are required to make the bottom of the trench horizontal and level. If unseen underground structures, high strength concrete, are encountered, extra payment shall be provided to the contractor with negotiations and actual calculations. If during excavation, exceptional conditions are encountered that the contractor deems outside of "normal" materials for excavation, the work shall not cease but documentation of the conditions shall be done immediately. The contractor needs to submit the purposed plan and schedule methodology. Before the implementation of the work, the materials required the equipments to be used need to be properly verified. Since the safety factor is directly related to the excavation, the contractor need to finish the job within the allocated period of time until and unless the contractor can provide a valid reason. As the excavation phase offers many hazards, the contractor shall have on site all needed materials barricading, caution lights & boards to protect the open excavation and warn any persons in or near the excavated areas before any excavation work shall commence. The Royalty charges are included in the material rates of Earth. Unless specified separately, the charges need not be paid extra. (To refer Part - I unit v) 1. Shoring and Protection: The contractor shall be responsible for all needed protection of adjacent structures, installation and design shall be his sole responsibility. The Executive Engineer shall assist as needed but implementation and protection shall be with the contractor. Any verifiable facilities initiated out of this work shall be rectified at the contractors own expense. It is advisable for the contractors that they maintain a record and photos of all the existing surrounding buildings in the area. It would be very useful, in-case certain claims occurs for the damage of the neighbouring building during the excavation of the site. Executive Engineer shall assist as needed as per requirement for the unnecessary claims, if proper management records are maintained. The contractor accepts sole responsibility for any damage to adjoining properties incurred in the performance of the work. It is highly recommended that a record of all adjoining properties be maintained at site (photos and brief written descriptions). When the depth of foundation is below 3.5 m, and where shoring is necessary, all the aspect shall depend upon the type of soil; the Contractor shall be responsible for the design of shoring for proper excavation. Shoring shall be of sufficient strength to resist side pressure ensuring safety from slippage, preventing damage to work and property and injury to persons. It shall be metal sheet piling or any other approved means strong enough to retain the earth and protect the existing structures against any damages. The contractor shall prepare and submit the method, details and process of such shoring to the consultant before starting earthwork for the basement or as per the specification. It shall be removed as directed after all the items for which it is required are completed. Foundation pits, well pits and similar excavation shall be securely fenced and marked with red lights at night and be in charge of watchmen to avoid accidents. Adequate protective measures shall be taken to see that the foundation excavations do not affect or damage adjoining structures. All measures required for the safety of the excavation, the people working in and near the foundation trenches, property and the people in the vicinity should be the responsibility of the Contractor. The Contractor shall be

entirely responsible for any injury to life and damage to property caused by his negligence or accidents due to his construction operations. The work will be in two stages: this includes excavation of the basement and earth filling works. The contractor will ensure that for both stages all safety measures for the excavated areas with necessary fencing, lighting etc are provided on instruction and approval of the consultant. No extra shall be paid in this connection unless otherwise specified. Any excavation deeper than 3.5 m shall be deemed as mandatory for placement of properly designed shoring to protect workers and work at the perimeter of the excavation, any other areas found to be unstable, shall at the request of the Executive Engineer be stabilized with properly designed shoring. Design and methods shall be approved as per the stated criteria by the Superintending Engineer prior to any further work in those areas. 2. De-watering: The Contractor shall not be paid extra for bailing out or pumping out of water which may accumulate in the excavation during the progress of the work either from seepage, springs, rain from neighboring properties or any other source; any equipment shall be removed after their purpose is served. Any soils deemed saturated and unfit to support foundation shall be removed and replaced with materials of appropriate to support the structure. Placement shall be as per requirements to bear / with stand the weight of the structure and minimize and future settlement. The act of dewatering shall in no way be a determent to the community at large or inflict any undue stress on the communities' infrastructure. Pumping water from any foundation enclosure or trenches shall be generally in such a manner as to preclude the possibility of any damage to the foundation trenches, concrete or masonry or any adjacent structure and pumbed water to be bailedout to nearby drain depending the quantity of water. The excavation shall be kept free from water (i) during inspection and measurement, (ii) when concrete and/or masonry works are in progress and until they come above the natural water level and (iii) until the Executive Engineer considers that the concrete/mortar is sufficiently set. 3. Trimming and levelling: The bottom of all foundation should be trimmed and levelled in accordance with the sanctioned drawings. The bottom of the foundation shall be rammed and watered before concrete is deposited. The term "watered" shall be deemed to mean a condition of water content giving optimum consolidation of the soil in the compaction process, it shall not mean a condition reflecting total saturation of the soil, or flooding. Measurement: For Earthwork measurements, the detailed procedures enumerated in the IS 1200-1992 (Fourth revision) to be referred & followed. Other necessary information on Earthwork Excavation & Back filling: No black cotton soil or any other inappropriate materials shall not be used for the backfilling works. The contractor and Executive Engineer shall confer as to the appropriateness of the material to be used. If other material must be brought from outside to the site, the Executive Engineer shall give an approval prior to bring on site. The openings around the foundation, pipes and drains in trenches shall be cleared of all debris, brick-bats. The fillings shall be done in layers, not exceeding 150 mm each layer. Each layer shall be watered, rammed and consolidated before the succeeding one is laid. Earth shall be rammed with proper compaction machines, as required by the site condition. Special care shall be taken that no damage is caused to the pipes, drains and masonry in the trenches below underneath. All lines and levels for excavation, filling and backfilling work shall be based on the consultants' benchmark or reference point, and survey work shall be done under the direction of Engineer or surveyor retained by the contractor. During filling of earth, the contractor needs to make necessary arrangements such that earth is properly consolidated. The contractor need to ensure that adequate amount of water is left on top of the daily filled earth so that proper consolidation occurs. The contractor shall test the compacted earth if desired by the Executive Engineer. The density for the back fill earth shall not be less than 95% of the proctor density to the original earth unless specified in the BOQ or Scope as approved in the Work order.

**General**

This specification establishes and defines the requirement of various materials to be used in Civil and Structural works for the materials or items listed or detailed in the Technical bid or in scope or in the specifications only to be used .

## 4.0 Clearing of Site, Excavation, Earth Filling and Landscaping

### 4.1 General

Trenches, pits for foundations of walls, column footings, rafts, pile caps, plinth beams, water tanks, cess pits, etc. shall be excavated to the length, width and depth as shown or figured on the drawing or as may be directed by the Engineer. If excavation is done to length, width or depth greater than as shown or required, the extra work occasioned thereby shall be deemed to have been done at Tenderer's expense and no payment will be therefore due. Extra depth shall be brought up by plain cement concrete filling of 1: 4: 8 proportion and extra length and width filled in by rammed earth or murum, or if the Engineer thinks it necessary for the stability of the work by 1: 4: 8 cement concrete, as may be directed by him at the Tenderer's cost.

Excavated material shall be used for filling in plinth, or the sides of the foundation blocks or trenches or spread on or near the site of work or elsewhere in the premises including watering, ramming and consolidating or carted away from site, if surplus, free of charge, as provided in the item specification.

The Tenderer shall at his own expense and without extra charge, make provision for supporting all utility services, lighting the trenches, pits, separating and stacking serviceable materials neatly, shoring, timbering, strutting, bailing out water whether of subsoil or rain water including pumping at any stage of the work. Trenches and pits shall be kept free of water while masonry or concrete works are in progress and till the Engineer consider it necessary.

### 4.2 Excavation excluding / other than in Hard Rock

Excavation shall be carried out in any type of soil, murum (soft or hard), soft rock, boulders, old foundations, concrete, asphalt or stone paved surfaces, old masonry or concrete (plain or reinforced).

### 4.3 Soft Rock

This shall include rock, boulders, slag, chalk, slate, hard mica, achiat, laterite, etc., which are to be excavated with stray blasting / without blasting or could be excavated with picks, hammer, crow bars, wedges. This shall also include excavation in macadam and tarred roads and pavements. This shall also include rock boulders not bigger than 1m in any dimension and not more than 500mm in anyone of the other two dimensions. Rubble masonry to be dismantled will also be measured under this item.

### 4.4 Excavation in Hard Rock

Rock, which is in solid beds, which can only be removed either by blasting or by wedging or chiseling shall be treated as hard rock. A boulder or detached rock measuring one cubic meter or more, shall also be treated as hard rock if the same cannot be removed without blasting, wedging or chiseling.

Where hard rock is met with and blasting operations are considered necessary, the Tenderer shall notify the Engineer of the same.

The Tenderer shall obtain license from District / Public authorities for carrying out blasting work as well as for obtaining, transporting and storing explosives as per 'Explosive Rules 1940' or as amended. He shall purchase the explosives, fuses, detonators, etc. only from a licensed dealer. He shall maintain the account of explosive material purchase and used by him. He shall be responsible for safe custody and proper accounting of explosive materials. The Engineer shall have access to check the store of explosives and accounts therefore.

Blasting shall normally be done with gun powder, Dynamite, Gelatin or any other explosive shall be use in special cases with written permission of the Engineer and District / Public Authorities concerned under 'Explosives Rules'.

Blasting operations shall be carried out under the supervision of a responsible representative of the Tenderer during certain hours, preferably during lunch break as approved in writing by the Engineer. The representative shall be conversant with the rules for blasting operations.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted and all people on work except those who actually light the fuses shall be withdrawn to a safe distance of not less than 100m from the blast. Blasting shall not be done within 100m of an existing masonry or any other kind of structures unless special precautions are taken by heavy blanketing, etc.

Where blasting is not practicable or is prohibited, excavation shall be done by wedging or chiselling and shall be restricted to the quantity required to enable the necessary foundations, etc. to be put in. In case, the dimensions of trenches, pits, exceed those shown in drawings or as directed by the Engineer, the excess quantity shall not be paid for. The item also covers bailing out subsoil or rainwater including pumping at any stage of the work, shoring, strutting, etc.

### 4.5 Earthwork excavation in general surface grading

Earthwork is to be done by excavation using mechanical equipment for cutting and leveling and transporting earth within the campus as directed, and in depths as directed at site.

The excavated earth shall be deposited within the campus as defined above, in layers of 15cm, consolidated and leveled. Excess earth if any shall be transported off the campus at Tenderer's risk and cost.

The levels taken, before and after cutting and leveling at intervals of 3 – 5m shall be the basis for excavation quantities and in assessing the surplus quantities general specifications for earthwork excavation and filling will be applicable for these items also except for the additional clauses stated above. Excavation with blasting / stray blasting is separately taken as an item.

### 4.6 Dismantling and Demolition

Specification covers the procedure and safety measures required for demolition and dismantling of masonry [Brick & Concrete (Plain & Reinforced), structural steel sheeted / un sheeted works.

Materials obtained from dismantling / demolition operations shall be the property of the BDA unless otherwise specified and kept in safe custody until handed over to the Engineer.

If it becomes necessary to disconnect any existing service such as electrical, piping, etc. during dismantling / demolition operation and where so required by the Engineer, suitable alternate arrangement shall be made by the Tenderer to maintain the continuity and proper functioning of the service line(s) at no extra cost of the BDA.

#### 4.6.1 Specifications

Tenderer shall adhere to safe demolishing / dismantling of all stages of work to guard against accidents, safe / unsafe working procedures.

Propping, under pinning shall be done for the safety of adjoining structures whose safety is likely to be affected before taking up the demolishing and dismantling work.

Enclosures / fencing, danger lights, etc. shall be provided as specified by the Engineer to prevent accidents.

Pipes, fixtures, etc. located in the vicinity shall be protected by suitable means as directed by the Engineer during demolishing and dismantling operation. Measures shall be taken to avoid the dust nuisance.

Dismantled elements / components shall not be dropped from a height or thrown from a distance so as to avoid damaging the same. Dismantling of elements (fixed by screws / bolts / hooks, etc). shall be done by taking out the fixtures with proper tools only. Such fixtures may be cut by sawing or flame cutting, in event of their being stuck up due to rusting etc. welds shall be removed by flame cutting. Tearing or ripping of elements shall not be resorted to under any condition.

**4.6.2 Procedure**

Entire work of demolishing & dismantling shall be carried out very carefully. Prior to start of work, the Tenderer shall prepare and submit the proposed scheme of demolishing & dismantling to the Engineer for his approval. Demolition of any structure shall be carried out in the reverse sequence followed at the time of its construction. Dismantling shall be done in a systematic manner. All elements shall be carefully removed without causing any damage. Chipping of concrete / grout shall be done with precision by chiselling. The finished surfaces shall be made true to the requisite size and shape. Pockets / holes of specified size shall be made / cut by chiselling / drilling.

**4.6.3 Cleaning & Stacking**

Wherever directed, retrieved material such as bricks / stones, reinforcement bars, sheeting, etc. shall be separated out, cleaned and properly stacked.

**4.6.4 Disposal**

All unserviceable materials shall be disposed off as per the directions of the Engineer.

**Earth Filling**

**5.0 General**

Filling shall be done with good approved earth, murum, gravel, or quarry dust. It shall be free of salts, organic matter, black cotton soil or slushy earth and combustible material. All clods shall be broken thoroughly and properly.

**5.1 Filling in plinth / sides of foundation**

Shall be done in layers not exceeding 15cm, adequately watered and consolidated by ramming with iron or wooden rammers weighing 7 to 8 kg and having a base square / circular of 20cm side / diameter. When the filling reaches the finished levels, the surface shall be flooded with water for at least 24 hrs, allowed to dry and then rammed and consolidated after making good any settlement in order to avoid such settlement at a later stage. Special care shall be taken to pack earth under plinth beams and column corners. Finished level of filling shall be kept to the slope intended to be given to the floor.

**5.2 Filling in outdoor portions and for site development**

Shall be done in layers of 15 to 30cm as may be specified in the item specification. Each layer shall be adequately watered. When filling reaches the required level, the topmost layer shall be dressed to proper section, grade and camber and rolled by 8 ton power roller, adequately watered to aid compaction.

**5.3 Compaction**

Where compaction of 90% standard proctor density is called for such compaction shall be by mechanical means but the Tenderer may be permitted to adopt manual means only if the Engineer finds that the desired compaction is achievable in the field.

For compacting each sand layer, water shall be sprayed over it to flood it and it shall be kept flooded for 24 hours to ensure maximum compaction. Vibro – compactors shall also be used if necessary to obtain the required degree of compaction. Any temporary works required to contain sand under flooded condition shall also be undertaken. The surface of the consolidated sand shall be dressed to required levels or slope.

After the compacted fill has reached the desired level, the surface shall be flooded with water for 24 hours, allowed to dry and then rammed and consolidated to avoid any settlement at a later date. The compacted surface shall be properly shaped, trimmed and consolidated to an even gradient or level. All soft spots shall be excavated filled and consolidated.

The degree of compaction of compacted fill in place will be subject to tests in accordance with relevant Indian Standards as desired by the Engineer. As the work progress, the Tenderer shall provide the necessary facilities to make such tests. If any test indicates that the compaction achieved is less than the required as per design and functional requirements degree of compaction, the Engineer may require all filled places subsequent to the last successfully test to be removed and recompacted by the Tenderer. Compaction procedure shall be amended as necessary to obtain satisfactory results.

**5.4 Filling in plinth and ground with earth brought from outside**

Filling shall be carried out with approved material. The material shall be free from clods, salts, sulphate, organic & other foreign material. All clods of earth shall be broken or removed. The material and source shall be subject to prior approval of Engineer. The approved area, from where the fill material is to be dug, shall be cleared of all bushes, roots, plants and rubbish material. The materials so removed shall be burnt or disposed off as directed by Engineer. The Tenderer shall make necessary access roads to those areas and maintain the same, if such access road does not exist, at his cost. If any material is rejected by Engineer, the Tenderer shall remove the same forthwith from the site at no extra cost to BDA. Surplus fill material shall be disposed off by uniform spreading within the site as instructed by the Engineer.

The compaction shall be carried out as specified in the item no. **5.3**.

**5.5 Dry Rubble Packing**

Ground shall first be leveled up and thoroughly consolidated by means of heavy log hammers or from rams. Rubble of specified thickness shall then be laid and set with hand. It shall be consolidated by either hand roller or wooden log hammers, water being freely used during consolidation. All hollows and interstices after consolidation shall be filled up with quarry spills, stone chips, etc. and the packing blinded with stone grit, watered and consolidated by log hammer.

Rubble packing in road work shall be thoroughly consolidated by means of power roller of 8T capacity instead of log hammers and the surface shall be brought to proper grade and camber. After checking the level, grade and camber the surface will again be watered and rolled to receive road structure.

**5.6 Levelling Course**

The ground shall be prepared as for Dry Rubble Packing as above. The course shall be either plain cement concrete of lean mix or lime concrete, which shall be proportioned as stipulated in the relevant item and mixed and placed in position, conforming to line and level shown on the drawing and compacted by approved means and cured adequately.

Lime concrete shall be prepared by mixing sand and slaked lime in proportions of three parts of sand and one part of lime and ground in a suitable mill and the mortar so prepared shall be added to six parts of brick bat passing through 50mm mesh, mixed well and placed in position and compacted by approved means. The concrete shall be cured adequately.

**5.7 Sand filling in plinth / foundation**

Filling shall be carried out in layers not exceeding 15cm and shall be compacted mechanically or by saturation to specified grade level and to obtain 90% laboratory maximum dry density or as specified in schedule of rates. Compaction by flooding may be accepted at the discretion of the Engineer, provided the required compaction is achieved. The Tenderer shall not commence filling in and around any work until it has been permitted by the Engineer.

**Landscaping Work**

**6.0 Scope of Work**

The Tenderer shall provide all operations and services specified on the drawing, schedule of quantities as specified herein or both, including labour, equipment, services and transport, all plant materials, top soil plants, preparation of final planting locations, spraying before plants (if necessary), staking, supporting, wrapping and tying plant materials, disposal of debris and unused materials. Guarantee of trees and plants for a period of 3 years. Visiting, inspecting and consulting for the period of 3 years.

# Definitions

( NBC)

1. **Avenue** : A wide road or pathway lined with trees on either side.
2. **Buffer** : The use of landscape to curtail view, sound or dust with plants or earth berms, wall, or any such element.
3. **Climber** (Creeper/Vine) : A non-supporting plant, woody or herbaceous, which clings to a wall, trellis or other structures as it grows upward.
4. **Columnar** : A slender, upright plant form.
5. **Egress** : A way out, or exit.
6. **Elevation** : A contour line or notation of relative altitude, useful in plotting existing or proposed feature.
7. **Exotic** : A plant that is not native to the area in which it is planted.
8. **Fencing** : A barrier of plant or construction material used to set off the boundary of an area and to restrict visual or physical passage in or out of it.
9. **Foliage** : The collective leaves of a plant or plants.
10. **Geo-textile** : Any permeable textile (natural or synthetic) used with foundation, soil, rock, earth or any other geotechnical engineering-related material as an integral part of a human made project, structure or system.
11. **Grade** : The slope or lay of the land as indicated by a related series of elevations.

**11a Natural Grade :** Grade consisting of contours of unmodified natural land form.

**11b Finished Grade :** Grade accomplished after landscape features are installed and completed as shown on plan as proposed contours.

12. **Gradient :** The degree of slope of a pipe invert or road or land surface. The gradient is a measure of the slope height as related to its base. The slope is expressed in terms of percentage or ratio.

13. **Grading** : The cutting and/or filling of earth to establish smooth finish contours for a landscape construction project. Grading facilitates good drainage and sculpts land to suit the intent of landscape design
14. **Grasses** : Plants that characteristically have joint stems, sheaths and narrow blades (leaves).
15. **Groundcover** : The planting material that forms a carpet of low height; these low-growing plants are usually installed as the final part of landscape construction.
16. **Hard Landscape** : Civil work component of landscape architecture such as pavement, walkways, roads, retaining walls, sculpture, street amenities, fountains and other built environment.

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17. **Hardy Plant** : Plants that can withstand harsh temperature variations, pollution, dust, extreme soil conditions, and minimal water requirements and the likes. These plants have ability to remain dormant in such conditions and survive.
18. **Hedge** : Number of shrubs or trees (often similar species) planted closely together in a line. A hedge may be pruned to shape or allowed to grow to assume its natural shape.
19. **Herb** : An annual plant with a non-woody or fleshy structure. Certain herbs are highly useful for cooking or of high medicinal value.
20. **Ingress** : A way in, or entrance.
21. **Invert** : The low inside point of a pipe, culvert, or channel.
22. **Kerb** : A concrete or stone edging along a pathway or road often constructed with a channel to guide the flow of storm water and thereby serving dual purpose.
23. **Mound** : A small hill or bank of earth, developed as a characteristic feature in landscape.
24. **Native :** A plant indigenous to a particular locale.
25. **Planting** : Planting is the operation of transferring young plant from nursery to their permanent place in landscape.
26. **Screen** : A vegetative or constructed hedge or fence used to block wind, undesirable views, noise, glare and the like, as part of in landscape design; also known as 'screen planting' and 'buffer plantation'.
27. **Sediment** : The product of erosion processes; the solid material, both mineral and organic, that is in suspension, is being transported or has been moved from its site of origin by air, water, gravity or ice.
28. **Shrub** : A woody plant of low to medium height, deciduous or evergreen, generally having many stem.
29. **Soft Landscaping** : The natural elements in landscape design, such as plant materials and the soil itself.
30. **Spot Elevation** : In surveying and contour layout, an existing or proposed elevation noted as a dot on the plan.
31. **Street/Outdoor Furniture** : Items of furnishing in outdoor landscape.
32. **Swale** : A linear wide and shallow depression used to temporarily store, route or filter runoff. A swale may be grassed or lined.
33. **Topsoil :** The uppermost layer of the soil.

34. **Transplanting :** Moving a plant from its place of origin to another location.

    Transplanting is the process of bodily lifting of mature and large plants from their position to a new position.

35. **Tree :** A woody plant, generally taller than 2.00 m, with a well-distinguished trunk or trunks below the leaf crown.

**35a. Deciduous Tree :** Tree that sheds all its leaves in autumn or in dry season.

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**35b. Evergreen Tree :** Tree that remains green for most part of the year and sheds leaves slowly throughout the year.

**36. Tree Grate :** A metal grille, installed at the base of a tree otherwise surrounded by pavement, that allows the free passage of air, water, and nutrients to the tree root, but does not interfere with the foot traffic.

**37. Tree/Plant Guard :** The protection constructed around a tree to deter vandalism and help to prevent damage. It could be made of metal, bamboo or concrete or the like.

# 38. Planting Design Consideration

**The following criteria shall be considered in planting design :**

1. Plant Material
2. Soil conditions
3. Availability and quality of water
4. Availability of sunlight
5. Quality of air
6. Maintenance
7. Functional Aspects of Design with Plants
8. Planting for Shelter and Soil Conservation
9. Air Pollution Control by Plants

**1. Plant Material**

The major sets of factors that influence the choice of plant material are related to the characteristics, both botanical and physical of plant material and the context in which the plant material is to be used. The inter-relationship of these sets of factors is the basis for developing a sound approach to the process of designing with plants

**Physical and Botanical Characteristics of Plant Material**

The information on plant material should be available in a systematic format to include definition, significance and design implications of the following aspects :

(a) Nomenclature (botanical and trade-name);

(b) Origin, family and natural habitat;

(c) Growth characteristic and form as a function of habitat;

(d) Physical characteristics, for example bark, texture, foliage, etc.

(e) Propagation and maintenance; and

(f) Use in landscape design.

– **Vegetation Types (Evergreen and deciduous) :** Some examples of the functional implications of using evergreen and deciduous plant material for specific situations are :

**(a) Evergreen trees for :**

(i) Places requiring shade throughout the year,

(ii) Strong visual screening

(iii) Part of windbreak or shelter planting, and

(iv) Areas where leaf lifter is to be discouraged.

**(b) Deciduous trees for :**

(i) Greater visual variety,

(ii) Partial visual barrier,

(iv) Areas where under-planting is to be encouraged (for example grass), Emphasis on branching and flowering pattern, and

(v) Areas where shade is not required throughout the year.

**Growth Habits of Various Kinds of Vegetation and Their Form :** The overall physical form of a plant is usually the result of the foliage density and branching pattern. It may also be expressed as the proportionate relations between height and canopy spread. The later is direct expression of growth habit. The following classification into basic types may be useful (Also Refer : Chapter on List of Trees)

**(a) Trees of fastigited or columnar habit –**

Examples of trees of this type are :

Casurina esquisitifolia (beet wood)

Grevilea robusta (Silver Oak)

Polyathia logifolia (Ashok)

Populus species (Poplar)

Though the branching pattern of each is different, the overall shape is similar

**(b) Tall trees with canopy –**

Examples of trees of this type are :

Dalbergia sissoo (Sheesham)

Tamarindus indica (Imli)

Terminalia arjuna (Arjun)

The canopy share does not fit into any specific geometrical category

**(c) Trees of spreading habit –**

Example of threes of this type are :

Delonix regia (Gulmohar)

Lagerstroemia flosreginae (pride of

India) Pithecolobium saman (Rain Tree)

Though these trees vary greatly in size, their basic form is similar

**(d) Trees of weeping habit –** Examples

of trees of this type are : Callistemon

lanceolatus (Bottle brush)

Salix babylonica (Weeping willow / Peking willow).

The above classification is helpful in choosing various combinations of the above types to achieve desired function and visual objectives.

## 2. Soil Conditions

Physical as well as chemical properties of the available soil are important. These may or may not be amenable to change; they would therefore affect the choice of plant material considerably. Physical properties include consideration of light (for example sandy) and heavy (for example clayey) soils, and their structure. Chemical properties pertain to the presence or absence of nutrients and salts; soil, alkalinity or acidity. A effective planting schemes.

## 3. Availability and Quality of Water

The water requirement may be derived by data of humidity and rainfall of plants natural habitat. The water table of the area where the plantation is to be done has a crucial bearing on the design with plants as well as a financial implication for reduced maintenance if planted appropriately.

**4. Availability of Sunlight**

The growth rate of plants are directly related to sunlight availability; such as plants that require (a) full sunlight, (b) partial sunlight, (c) predominantly shade, and (d) complete shade.

**5. Quality of Air**

Growth may be affected by chemical pollutants such as sulphur dioxide or physical pollution such as dust. Certain plants have the ability to withstand pollution, such plants are imperative for industrial areas, roads, highways, etc.

**6. Maintenance**

The success of a designed landscape depends upon the growth of vegetation over an extended period of time; therefore maintenance of landscape is also a design component.

**7. Functional Aspects of Design with Plants**

(a) Improve existing environmental conditions with respect to soil, drainage, microclimate, air pollution;

(b) Create a designed physical environment through the organization of open space; and

(c) Interpret and express the contemporary understanding of the man-nature relationship, that is, design with plants on an ecological rather than horticulture basis.

**Shrubs**

– The functions are similar to those o trees. Shrubs may be used together with trees to reinforce the functions, for example, noise barrier, shelter belts, enclosures, etc.

Other forms in which shrubs may be used are:

**(a) Hedges :** These require regular maintenance

**(b) Shrubbery :** Here plants are allowed to retain their natural shape; they therefore require little maintenance.

Shrubs provide barrier, which may either be visual or physical (hedges). Barriers may be required in a range of situations, for example they may be only for defining space, or they may be required for security and have to be, therefore, necessarily impenetrable.

**Groundcover**

– Groundcover plants are those which naturally grow to a very low height. Some of the uses for which they may be used are:

(a) Stabilization soil on steep slopes such as embankments.

(b) As a low maintenance substitute for grass (where the surface is not to be used).

(c) For providing variety in surface treatment.

(d) Contrast with paving materials, for example to soften rigid lines of paving.

(e) As a subtle means of demarcating space, as for example, in places where tall plants would be visually intrusive.

(f) In combination with other plants to provide contrast or harmony in form.

**Climbers :** Certain climbers because of their spreading habits may also be used as ground cover(for example Asparagus spp.) Climbers are useful for shading exposed walls from direct sunlight. They may also be used for stabilizing soil on embankments (for example, ficus stipulate, Ipomea biloba). On sites where a high degree of security makes fencing necessary, climbers and spreading plants like Bougainvillea species, may be trained on boundary wall.

**8. Planting for Shelter and Soil Conservation**

The use of vegetation for controlling wind is widely recognized as an effective way of conserving soil and reducing erosion by wind. Vegetation may therefore be used for modifying the microclimate, by obstructing, guiding, deflecting or filtering wind current.

Vegetation areas designed to fulfill these general functions are usually classified as windbreakers and shelterbelts. Windbreaker is grown protective planting around gardens and orchards. Windbreakers generally consist of single or double row of trees. Shelterbelt provides an extensive barrier of trees with several rows of trees. Plant species are chosen with particular regard to their physical and growth characteristics, and their effectiveness in achieving the desired results.

**Function :** Windbreakers and shelterbelts fulfill essential microclimatic functions in rural and urban environments. Benefits accruing from plantation of shelter planting may be as follows :

(a) Reduction in wind velocity resulting in the arrest of movements of soil particles.

(b) Prevention of soil erosion.

(c) Modification of micro- climate; moderation of change in air temperature.

(d) Protection of crops from being blown by high winds.

(e) Reduction in evaporation of soil moisture. Increase in soil moisture content varies from 3 percent to 7.8 percent Water loss due to evaporation is lessened.

(f) Increase in soil moisture due to greater dew fall in sheltered areas has been found to be 200 percent higher than on exposed ground; heaviest dew fall is over a distance of 2 to 3 times the height of the shelterbelt.

(g) Beneficial effect on growth of plants that are affected by high winds.

(h) The zone of influence of shelterbelt on crop yield extends to a distance of 20 times the height of the belt, with the maximum effect being observed 10 times the height of the tree belt, on the leeward side.

**Wind Erosion :** Some of the basic functions of windbreaks and shelterbelts in arid and semi- arid areas are to conserve soil and reduce erosion by wind. The latter is a natural phenomenon in and lands having very little rainfall (125 mm- 250 mm) and in areas adjoining a river, lake or sea. Wind erosion is a serious problem in areas where the ground is virtually bare and devoid of vegetation.

**Techniques for control of wind erosion :** The principal method of reducing surface velocity of wind, upon which depends the abrasive and transportation capacity of wind, is by vegetation measures.

(a) Porosity is important in the effectiveness of shelterbelt and proper selection of tree species is necessary. Porosity near ground level is desirable.

(b) Effectiveness of shelter planting depends more on height and permeability than on width. The width influences the general microclimate but above a certain minimum width, it does not affect greater reduction in wind velocity.

Protection obtained varies in relation to height (H) of shelterbelts as given below :

| Distance | Wind Reduced by (in percent) |
|---|---|
| H | 90 |
| 2H | 75 |
| 5H | 50 |
| 10H | 20 |

This indicates that it is better to have several windbreaks 5H to 6H apart rather than large forest stands with wide open spaces in between.

**Species suitable for wind breaks are :**

**(a) For Dry and Arid Regions**

(i) Acacia auriculiformis (Australian Blackwood)

(ii) Ailanthus excelsa (Maharukh)

(iii) Albizia lebbeck (Siris)

(iv) Azadirachta indica (Neem)

(v) Casuarina equisetifolia (Beef- wood)

(vi) Dalbergia sissoo (Sheesham)

(vii) Eugenia Jambolana (Jamun)

(viii) Grevillea robusta (Silver oak)

(ix) Peltophorum ferrugineum (Cooper pod)

(x) Tamarindus indica (Imli)

(xi) Pongamia glabra (Indian beech)

(xii) Tamarix articulate (Tamarisk)

**10. Air Pollution Control by Plants**

Air pollution may be caused by areas or point sources such as cities, industrial areas, factories or by linear sources such as highways. Vegetation buffers can minimize the build-up of pollution levels in urban areas, by acting as pollution sinks.

**Effect of Plants :** Plant leaves function as efficient gas exchange systems. Their internal structure allows rapid diffusion of water-soluble gases. These characteristics allow the plant to respire and photosynthesize, and they can also remove pollution from the air. Some of the beneficial results of plantations may be:

(a) They are good absorbers of sulphur dioxide.

(b) Parks with trees have an SO2 level lower than city streets.

(c) Roadside hedges can reduce traffic generated air borne lead, on leeward side.

(d) Heavy roadside planting in the form of shelterbelts can result in a reduction in airborne lead.

(e) Complete dust interception can be achieved by a 30m belt of trees. Even a single row of trees may bring about 25% reduction in airborne particulate.

# Role of Vegetation in Landscape Design

With the advent of technology, the man is becoming isolated from nature day by day. The rapid urbanisation has resulted in diminishing the landscape features. The early culture of India is full of plant love, intimately concerned with the day to day life. With the increase in population and large scale Urban Development has taken a heavy toll on the green areas and has alienated the people from nature.

The trees play a vital role in a community's scenic beauty, the character of the local landscape and the overall quality of the environment. Despite their benefits, trees are disappearing faster than we think.

**Just imagine what our streets and neighbourhoods would be like without trees!**

**Benefits of Planting and Protecting Trees**

**Environmental Value :** Trees provide a variety of environmental values, including screening of unpleasant odours, absorption of noise and reduction of pollution and temperatures in the cities as described below :

**– Air Quality :** Trees are an efficient and cost-effective way for a community to improve its air quality and reduce pollution. A mature tree absorbs between 120-240 pounds per year of small particles and gases, like carbon dioxide, which are released into the air by automobiles and industries. In addition, a single tree produces nearly three-quarters of the oxygen required for a person; and a canopy of trees in an urban environment can slash smog levels up to 6%.

**– Water Quality :** Trees help anchor soil and reduce storm water runoff, saving the high costs of drainage ditches, storm sewers, and other "engineered solutions" to storm water management. A street lined with 32' tall trees can reduce runoff by almost 327 gallons, allowing cities to install smaller and less expensive water management systems. Reducing runoff also decreases topsoil erosion and the amount of silt and other pollutants washed into streams, rivers and lakes.

**Lower Heating and Cooling Costs :** Trees have demonstrated the ability to reduce heating and cooling costs and counteract the "heat island" effect in urban environments. Urban areas with little vegetation can experience temperatures of up to seven degrees higher than those with tree cover. This translates into significantly higher energy costs to cool buildings. Properly planted trees can cut heating and cooling costs by as much as 12 % and reduce overall power demand.

**Reduced Noise Pollution :** Noise pollution is an often overlooked problem. Excessive or unwanted sound has negative physical and psychological effects. Noise can come from many sources, especially roads and highways. Trees can play an important role in deadening unwanted noise. Sound waves are absorbed by a tree's leaves, branches, and twigs. Studies suggest that belts of trees 100' wide and 45' long can cut highway noise to half.

**Ecological Value :** Plants provide significant values to all sectors of natural environment in cities. The loss of vegetation cover adversely affects the soil, Air & Water balance.

– One of the major values of plants is improving of urban soil conditions. Urban soils are often buried beneath the sidewalks, streets and buildings. However, a significant portion in many urban areas remain exposed to environmental conditions which helps in improving urban soil conditions by building the Soil with roof system, by checking the loss of surface particles, by increasing the organic material contents in soil and retaining the water for longer period, to increase the ground water table. Soil benefits from trees, as their far-reaching roots hold the soil in place, preventing erosion. Trees improve soil quality as their leaf litter makes perfect compost. Some trees, for example acacias, have

bacteria living in their roots. The bacteria convert nitrogen from the air into nitrates, which the tree can use to grow and reproduce, whilst the soil is also enriched.

– Plants also help to control the extreme fluctuation in temperature and reduction of pollution level in urban atmosphere. Plants have a useful effect upon the climate e.g. a comparison of the temperature difference in summer, between a planted area of urban landscape and built-up central area is likely to be 2-3°C lower with a 5% increase in relative humidity.

– During the process of photosynthesis all green plants take in carbon dioxide and give off oxygen. Primitive plants were responsible for converting the poisonous atmosphere of early Earth into an oxygen-rich atmosphere that supports animal life. Trees help to maintain low levels of carbon dioxide, thereby reducing the greenhouse effect which threatens to make the Earth uncomfortably warm.

– Trees provide nest sites for birds. The leafy branches make good hiding places and are difficult for most predators to reach - even non-breeding birds roost in trees at night.

- **Health Value :** There is mounting evidence that stress and noise have an impact on our physical and psychological health. Trees and vegetation can affect our mood and help relieve stress.
- **Economic Value :** Trees are a major economic asset to a community, building a positive community image which is a key factor in attracting residents, businesses, and visitors alike. The attractively tree-lined public areas are more desirable than those areas without trees. The landscaped areas enjoy higher occupancy and rental/lease rates than identical properties that lack landscaping.

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**Shelter :** The shade of trees is welcomed by man and beast alike, providing essential shelter in the hottest climates. Trees are often used as windbreaks to shelter sensitive crops.

**Aesthetic Value :** Trees provide a variety of aesthetic values and accentuate the architectural design of buildings. For all their values to which a price tag can be attached, trees have one more contribution to make: their beauty and variety of form. Some species are tall and thin, others flat-topped and spreading, leaves come in every shape and size, flowers and fruits are frequently decorative. These qualities make trees ideal for beautifying gardens, cities, and even industrial estates.

Planting is much more than a cosmetic treatment to be applied to in different or insensitive architecture and engineering etc. It plays a major role in integrating structure into

environment, providing a setting and reducing their visual intrusions within the functional requirement of any single area. Plants are growing, ever changing, interacting organism and plant communities are in a constan state of flux. Plants, whether trees, shrubs, climbers, groundcovers have to be placed at suitable location so that the desired purpose is served.

The efficient and successful choice of plants should be made on the basis of their design characteristics :

1. **Functional & Structural Characteristics :** Plants in combination and individually, create space beneath, between & sometimes within the bulk of their canopies. Plants create landscape structure, which both defines spaces and serves the required function.

   Trees, in the city are living building material used to establish spatial boundaries. They create spatial rhythms to heighten the experience of moving through the outdoor spaces, its ability to shelter, screen or shade, density of roof growth which will determine its ability to bind the soil and protect against erosion. Plants also provide a fitting environment for human activities while avoiding damage to ecology of the landscape.

2. **Visual & Other Sensory :** Plants offer an enormous wealth of aesthetic characteristics, the appearance of their laves, twigs, bark, flower & fruit, the fragrance of flower and aromatic foliage, the physical texture of bark & leaves even the sound of laves when stirred by the wind or beaten by the rain.

3. **Plant Growth Habit & Cultural Requirement :** There is enormous diversity of size, habit foliage & other characteristics among the range of species; that helps to determine the habitat & ecological niche. In the first place, planting design can help us make the best use of our environment. Secondly, it helps to restore the balance between people, nature and in some extent to the wild life and finally it offers many opportunities for enjoyment of aesthetic delights.

4. **Plants and Their Uses :** Plants are positive design elements in any environment and they can enhance the environment, if used with proper understanding

   **Trees (basic planting) :** This relates to the contemporary requirement in landscape design for mass planting of large groups, woodlands, which with the topography or land form, produce the large scale spatial arrangement of the landscape. The species selected for this group should be hardy, vigorous in growth, indigenous for ecological reasons and exotics which have become established as part of local scene.

   *e.g.- Acacia auriculiformis, Lagerstroemia flos reginae (pride of india), Pterospermum acerifolium (kanak champa), Alstonia scholaris, Putranjiva roxburghii (jalpitri), Azardirachata indica (neem), Dalbergia sissoo (sheesham) etc.*

   **Trees (special effects) :** Trees in this section should include those sufficiently individualistic, spectacular or strong in character to occupy the isolated positions, either

because of these qualities or because they do not mix easily in visual sense with other trees.

*e.g.- Ficus bengalensis (banyan tree), Cassia fistula (amaltas), Bombax malabaricum (silk cotton tree), Cassia nodosa (pink javanica), Jacaranda mimosaefolia (neeli gulmohar). Chrosia speciosa, Mimusops elengi (mulsari) Callistemon lanceolatus (bottle brush) etc.*

**Trees (barriers) :** Barriers formed with plants are needed in landscape for screening the unpleasant views, for dividing up the landscape into spaces, for providing shelter from wind, for protection against pollution, for defining boundaries and for assisting in the creation of beautiful landscape.

*e.g.- Casuarina equisetifolia, Grevllea robusta (silver oak), Ficus benjamina, Polyalthia longifolia (ashok), Putranjiva roxburghii, Schleichera trijuga (kusum), Golden bamboo etc.*

**Shrubs (basic planting) :** The use of shrubs in the mass as a basic constituent of the planting of Landscapes. It should have the qualities of hardiness, vigorous growth with a greater emphasis on evergreen plants.

*e.g.- varieties of Acalypha, Bougainvillea, Cassia biflora, Cassia alata, Duranta, Ficus panda, Euphorbia, Thevetia, Taberneamontana (chandni), Palms such as areca, china, phoenix, rhapis etc.*

**Shrubs (special effects) :** Similar principles of selection apply to this as for trees (special effects), but at the same time it should be noted down that a number of shrubs planted together can produce special effects specially at the time of flowering.

*e.g. – Caesalpinia pulcherrima (peacock flower), Calliandra haematocephala, Poinsettia, Mussaenda, Justicia, Ixora, Bamboo-buddha valley, Franciscea latifolia (yesterday, today and tomorrow), etc.*

**Shrubs (barriers) :** Impenetrability is essential unless the barrier is for visual purpose, thus the twigs or thorns are considered as an advantage. Other things to consider are the ability of the plant to accept pruning, either to control growth or to produce topiary effects.

*e.g. – Bouganvillea, Duranta plumieri, Duranta plumieri varigata, Duranta goldeana, Murraya etc.*

**Shrubs (edging) :** To outline the flower beds or other kinds of plants and to create line effects.

*e.g. – Duranta goldeana etc.*

## Selection of Plant Material for Landscape

The success of landscape design with plants depends on how to choose the appropriate plants for a particular situation. Thoughtful selection of the trees, shrubs, climbers, bulbs, foliage plants, grass, groundcover and aquatic plants transform the barren landscape into meaningful landscape. Efforts should be made to select an appropriate plant material for the given situation based on the following criteria :

(i) Habit (ii) Colour (iii) Season of flowering

(iv) Form (v) Rate of growth and Environmental considerations.

### 1. Trees

The selection of trees should be based on season, size, form, situational preferences of surroundings and artifacts.

### 1.1 Flower Colour

**White :** *Alstonia scholaris, Baiiasea minor, Magnolia pterocarpa Milingtonia horternsis and plumeria acurmnaata.*

**Yellow :** *Cassia fistula, Bauhinia tomentosa, Saraca indica, Peltophorum pterocarpum and Tabebuia spectabilis.*

**Red :** *Bombax ceiba, Amberstia nobilis, Cassia marginata*

**Scarlet :** *Barningtonia monandra, Cassia pavarnica Crennigena, Kelnbovia hospita.*

**Purple :**

*Lagerstroemia speciosa, Bauhinia purpurea, Melia azadirach, Pachira, rosea and Tabebuia rosea.*

**Orange, Red, Crimson, Scarlet :** *Butea monosperma, Colvia racemosa and spathpdea campanulata.*

**Blue, Mauve, Violet :**

*Jacarpanda aquisatifolia, Guaicum officinale, Millenia avaliolia and Solanum grandugkirum*

**Greenish Yellow :** *Monodora grandiflora.Casealpnia,*

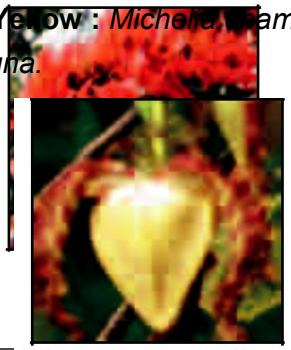
**Creamy White or Yellow :** *Michelia champaca, Madhuca Indica, Magnolia grandiflora and Terminalia Arjuna.*

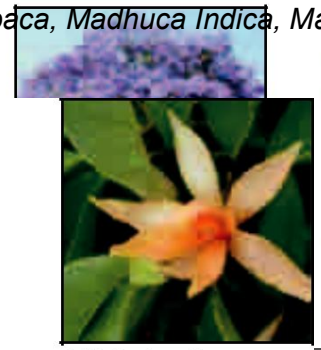
Alstonia scholaris

Cassia fistula

Bombax ceiba

Lagerstroemia speciosa


Monodora grandiflora


Micheia champaca


Barningtonia monandra

## 1.2 Season of blooming

**Ever blooming :** *Callisetermon lanceolatus, Mimusops elengi, Plumenia acuminata and Thespesia populnea.*

**Winter blooming :** *Bauhinia purpurea, Butea monrosperama. Monodora grandiflora*

**Spring blooming :** *Tabebuia, Amheristia niobilis, Bombax ceiba, Jacaranda, Saraca indica, Spathodea*

**Summer Blooming :** *Erithrina indica, Cassia, Jacaranda, Lagerstroemia spp.*

**Rainy season Blooming :** *Plumeria alba, Anthocephelus cadamba, Barringtonia raccemosa, Casia Marginata, P. rubra, Covillea raccemosa.*

Callisetermon lanccelatus

Bauhinia purpurea

Tabebuia

Erinthrina Indica

Plumeria alba

### 1.3 Range of Tree sizes

*Albizia lebbek* *Cassia fistula* *Peltophorum* *Ficus bengalensis*

**Dwarf trees (3 to 5m tall) :** *Albizia lebbek, Bisantha, Bixca orellana, Brownera grande eps, Crodia sebestena. Wevthrnia blackein Parkinsonia acuminata, Plumeria rubra.*

**Medium size (6 to 10m tall) :** *Caesalpinia, Lagerstromia throreli, Melia azadirach, Plumeria accmnata, Saraca Inidica, Tabeulia spectabilis.*

**Tall tress (more than110 m tall) :** *Peltophorum roxburghii, Bombax malabaricum, Cassia monisia, Chorisia speciosa, Jacaranda, Millingtonia hortensis, and spatholea campanulata.*

**Giant trees :** *Ficus bengalensis, Bombax ceiba, Colvillea racemosa,*

### 1.4 Growth Habit of Trees

**Oval: These plants are suitable for fra**

me or screen.

*Populus alba, Albizzia julibrissin, Crataeqs cerusoalli Cornus sp., Betula pendula Cassia fistula*

**Vase shaped :** They can be used above the large shrubs or small trees.

*Melia azadirach, Plumeria acutifolia. P.alba. P.obtusa, Saraca Indica. Almus Americana.*

**Pyramidal :** It can be used as an accent plant.

*Pinus roxburghii, Araucaria cooki. Thuja compacta, Quercus palustris, Stercula foedtida, Polyalthia longifolia.*

**Round :** These plants can be used in the lawn as specimen.

*Plumeria alba,Chorisia speciosa Mimusops elengi. Morus rubra, Quercus.*

**Columnar :** They frame the views and structure in the landscape setting. *Juniperus chinensis, Betula pendula, Quercus robustaj Eucalyptus robusta, polyelthia pendula.*

**Weeping :** It can be used as a focal point.

*Salix Babylonica, S. alba. Putranjiva roxburghii, callistemon lanceolatus Tecomelia.*

**Round to spreading :** These plants mass well to create grove effect. *Dalbergia sisso, Dillenia Indica, Ficus glomerata, Thespesia populnea.*

**Fan shaped** : They can be used as a focal point.

*Cycus revoluta, Borassus fladellifer, Oredoxa regia.*

Populus alba

Melia azadarach

Pinus roxburghii

Anthocephilus cadamba

Eugenia jambolana

**1.5 Trees with scented flowers :** *Anthocephilus cadamba, Alstonia scholaris, Cananqium odoratum Michelia champaca, Mimusops elengi, Dillenia indica, Gardenia latifolia, Custravia augusta, Magnolia grandiflora, Nyctanthes arbortristis.*

**1.6 Wind Resistant trees :** *Eugenia jambolana, Caesalpinia pulcharima, Peltophorum pterocarpum.*

**1.7 Salt Resistant trees :** *Azadirachta Indica, Acacia sp., Butea monosperma, Azadirachta Indica, Bassia Latifolia, Eucalyptus citriodora, Phoenix dactylorera and Phyllanthus emblica.*

Salix Babylonica

Dalbergia sisso

Cycus revolute

**1.8 Drought Resistant :** *Butea monosperm, Acacia sp., Albizzia lebbek. Casuaria equisetifolia. Crataeva religiosa. Tecomelia.*

**1.9 Wet Land trees :** *Nyctanthes arbortristis, Dillenia Indica, Michelia champaca, Saraca Indica, Thespesia populnea, Salyx Babylonica, Ecualyptus eostata, Guaicum officinalis.*

**1.10Fast Growing Trees :** *Pongamia glabra, Sesbania grandiflora, Cananqium odoratum, Erithrina Indica, Thespesia populnnea, Populus sp., Salix sp,. Euclyptus sp., Thuja compacta.*

**1.11 Shade givers :** *Pteropsperum acerifolium, Albizzia lebbek, Pelptophorum, Michelia champaca, Anthocephalus cadamba, Dalbergia sisso,. Glyricidia Maculata accer sp., Cornus florida.*

**1.12Trees tolerant to Dust and Smoke :** *Acacia auriculiformis, Alstonia soholaris, Butea monosperma, Ficus Benjamina, F. benghalensis, Madhuca Indica, Pongamia glabra, Ficus religiosa, Terminalia Arjuna, Albizzia llebbek, Bombax ceiba.*

**1.13Trees for Noise Reduction :** *Terminalia Arjuna, Alstonia scholaris, Azadirachta Indica, Butea Monosperma, Mangifer Indica, Madhuca Indica, Juniperus chinesis, Eucalyptus Citradora, Kigelia pinnata*

*Azadirachta indica*

*Butea monosperm*

*Nyctanthes arbortristis*

*Pteropsperum acerifolium*

*Acacia auriculiformis*

*Terminalia Arjuna.*

*Pongamia glabra*

# ansplanting of Trees

## Planting

### Definition

Planting is the operation of transferring young plant from nursery to their permanent place in landscape.

### Steps Involved in

### Planting Site

### Condition

The conditions of the planting site are as important as the plant. Soil type and drainage, available water and sunlight, exposure to dying winds, and other factors must be considered.

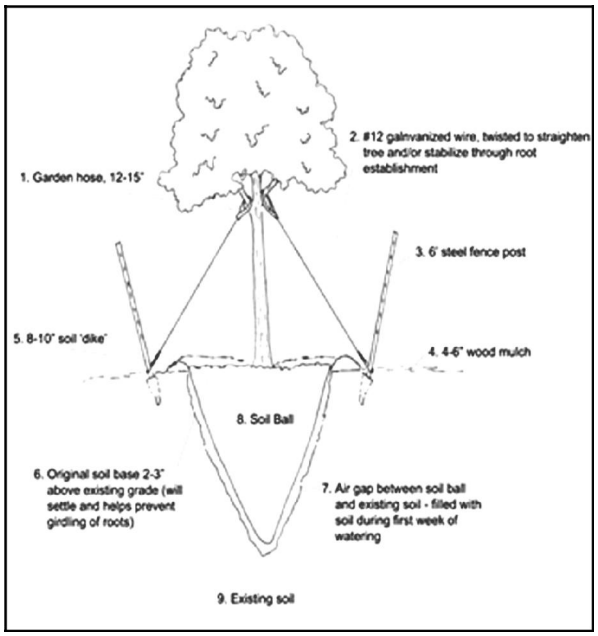

1. Garden hose, 12-15"
2. #12 galvanized wire, twisted to straighten tree and/or stabilize through root establishment
3. 6' steel fence post
4. 4-6" wood mulch
5. 8-10" soil 'dike'
6. Original soil base 2-3" above existing grade (will settle and helps prevent girdling of roots)
7. Air gap between soil ball and existing soil - filled with soil during first week of watering
8. Soil Ball
9. Existing soil

Fig:http://www.sustland.umn.edu/implement/treespade.htm

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Attempting to match the requirements of the plant to the site increase the survivability, performance, and longevity of the plant selected.

### Soil Texture

The first step in assessing the condition of the planting site is to examine the soil. Whether the soil is sandy and well drained, or is it moist with some organic material, or is it heavy clay and therefore, wet and perhaps compacted.

Construction practices such as cutting and filling, installation of underground utilities, and backfilling against foundations can create great diversity in soil structure. This variability can change drastically with depth and between planting locations on the same property-investigate each planting site.

Soil texture and drainage are closely related. Sandy soils usually are very well drained, have large pore spaces, and poor water- holding capabilities. They are usually associated with dry conditions.

Conversely, clayed soils have much smaller pore spaces, are poorly drained, and can suffocate plant roots. The pore spaces in soil are very important to plant growth because the oxygen that occupies them is essential to healthy roots. A tree planted in poorly drained soil will be slow to establish, lack vigor, and often will slowly die.

r o c e s s o f P l a n t i n g a n d T r

### Drainage

Because plant roots require both moisture and oxygen for growth, soil drainage should be checked before planting. A poorly drained soil, high in moisture but low in oxygen, prevents both proper root development and growth of beneficial soil micro-organisms that are responsible for decomposing organic matter and releasing plant nutrients.

To test for soil drainage, dig a hole 18 inches deep, fill it with water, and let it stand overnight. If the water has not drained by morning, there is a draining problem. (Do not leave the drainage in this matter after heavy rainfall or before the ground has thawed in the spring).

If soil drainage is inadequate, species that are tolerant of poorly drained soils may be planted, or soil drainage may be improved. This can be done in two ways. If a hard pan

p nderlying layer of well – drained soil, a hole can be dug down to the permeable layer to provide drainage for the planting hole.

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If the soil is poorly drained and there is no well-drained layer below, a tile system can be laid. However, this is expensive and requires the assistance of a professional for proper design. Simply adding gravel to the bottom of the planting hole will further decrease oxygen availability to the root system.

Compaction of the soil by vehicles or people can reduce pore space and restrict water infiltration, as well as cause physical damage to roots of existing trees. In compacted soil, oxygen is depleted, carbon dioxide accumulates, and root penetration is reduced. This is detrimental to root growth. Aerating the soil will help correct the problem.

Soil pH is a measure of the acidity or alkalinity of a soil. A pH below 7 (7 is neutral) would indicate an acidic soil, and a pH above 7 indicates an alkaline soil. Many plants have an optimal range of pH. Most trees thrive on a pH between 5.5 and 6.5. Soil pH is raised by calcium carbonate or lime. Plant species that will tolerate a high pH should be considered for areas with buried concrete, near foundations, or sidewalks etc.

Before a plant is planted on a particular site, a soil test should be conducted to determine possible pH problems or nutrient deficiencies.

**Water**

The correct amount of water for plants is essential. Selected plants that are tolerant of excess water for low areas where water may be standing or very close to the surface, or where a heavy clay soil exists. Standing water or a high water table means low oxygen content in the soil. Therefore, trees and shrubs that can tolerate excessive moisture are often better suited to these poor sites.

**Sunlight**

Although some plants can tolerate low light conditions, most require full sun to maintain their vigor and attain their full potential. Some plants may require some protective shade to prevent leaf scorch and desiccation.

**Location**

The location of the planting site in relation to other trees and objects such as buildings, fences, etc. will have a considerable influence on temperature and moisture conditions around the tree. Prevailing westerly winds have a drying effect on non-protected sites. The south side of a building will be much warmer and drier than the north side. The warming effect of the sun on a cold winter day can cause injury to the bark and may cause the tree trunk to split. For evergreens, this warming can cause water loss and growth activity resulting in needle damage when the temperature is again lowered Plant hardiness can be greatly affected by the amount of protection provided by individual microclimates.

**Planting Procedure**

**Preparation of Pit**

Pit should be prepared two months prior to planting to help the soil expose to the scorching sun.

Tree pit should be 1.2mX1.2mX1.2m. The pit should be properly dug as per specification. Poor digging with improper base dimension would lead to the undernourished growth of the plant.

While excavating, remove the top soil to a depth of 6" to 9" and keep it aside. Topsoil undergoes change in fertility status in the span of two months (between December and February)

If the subsoil is poor in terms of water holding capacity etc., it must be treated with 3 parts of manure + 2 parts of sweet earth + 1 part of sand(3:2:1). This will improve the drainage conditions and also enhance the acquired fertility of the soil.

Manure might generate heat after water is added. Hence, precaution must be taken to protect the plants. Also one third of compost manure is added at the time of refilling.

After refilling, soil is consolidated by watering. Soil should be allowed to get dried up by exposing it to the sun.

## Post Planting Care

### Watering

Too much or too little water after transplanting is a major cause of tree or shrub loss. The site should be thoroughly watered immediately after planting.

Thereafter, the soil must be regularly monitored to prevent drying out.

If rainfall is inadequate, the soil around the plant's roots should be deeply watered approximately every 10 -14 days.

If unsure if the soil is drying, dig down 3 to 4" next to the plant. Wet soil at that depth verifies watering is not needed at that time.

### Mulch

Mulches help conserve moisture, moderate soil temperature and control weeds around trees and shrubs.

They are placed on the soil surface over the tree or shrub root system. Either organic or inorganic mulches may be used.

Organic mulches may be composed of bark or wood chips, straw, partially decomposed leaves or other materials.

They should be applied 3 to 4" deep. Maintain a 4 to 6" mulch-free area adjacent to the woody stems.

Inorganic mulches include crushed rock, woven fabric, and other materials. Should plastic mulches may impede or prevent root development because they do not allow air or moisture to move into or out of the soil from above?

Occasionally, when soil is poorly drained, mulch should not be used.

### Fertilizer

For the first few years, woody plants rarely need nutrients beyond those naturally occurring in the soil. No fertilizer or manure should be mixed with the fill soil, as this could cause root damage.

If transplants appear to need fertilizer during the first few years, a totally soluble complete fertilizer should be applied.

### Pruning

Pruning may be required when transplanting trees or shrubs. The amount of pruning depends on the size of the root ball and plant canopy, health of the plant, and the species transplanted.

Insect infested stems or those infected with disease should be removed during transplanting.

Any broken stems should be removed as well.

Additional pruning of shrubs may be required to balance the leaf area with the reduced size of the root system, but further pruning of deciduous trees should be postponed for at least one year after transplanting.

Pruning of conifers should be limited to diseased, insect, and broken limbs. If additional pruning of conifers is necessary, it should be limited to one-year-old wood whenever possible.

Late season plantings may require additional pruning since the plants have less time to become established before winter than those planted earlier in the season.

**Mechanical Support**

Mechanical support for trees may be necessary when the tree is tall, slow to recover, heavily foliaged, or planted in a sandy site.

Most small trees and shrubs do not require staking or other support and will develop strong trunks faster if allowed to move freely with the wind.

For trees that do require mechanical support, staking may be used. Two stakes can be placed opposite of each other and the tree anchored to the stakes with a nonabrasive material, such as a soft, board, fabric strap.

Any support provided to a tree should be removed as soon as the tree can stand alone, usually after the first growing season. The sooner the support is removed, the faster the tree will become stronger.

**List of Major Avenue Trees**

| | | | |
|---|---|---|---|
| 1. | Terminalia (Arjun) | arjuna | Janpath, Park Street, Mother Teresa (Mixed), BKS Marg |
| 2. | Azadirachta (Neem) | indica | Aurangzeb, Shahjahan, Prithviraj, Aurbindo, Tees January, Safdarjung, Kamal Attaturk, KG, Rafi, Talkatora Road, Lodi, Sansad Marg, Pandara Road, Jai Singh, Jantar Mantar, GRG. |
| 3. | Tamarindus (Imli) | indica | Tilak Marg, Akbar Road, Teen Murti Marg |
| 4. | Syzygium (Jamun) | cumini | Ashoka, Rajpath, Sunehri Bagh, Tughlaq, Motilal Nehru, Feroze Shah, Raisina, Rajaji, Tyagraj, Kushak , Talkatora Road, Tolstoy, Mahadeva Road |
| 5. | Kygelia (Kygelia) | pinnata | Purana Quila Road, Babur |
| 6. | Ficus (Pilkhan) | infectoria | Krishna Menon Marg, Dr. Zakir Husain, Bhagwan Das Road, Blawant Rai Mehta Lane, Nyaya, Niti Marg, Dalhousie, Bhagwan Das Road, Satya Marg, Church Road. |
| 7. | Ficus (Pipal) | religiosa | Mother Teresa Road, Panchsheel Marg, Sardar Patel, Mandir Marg, KG, Africa Avenue |
| 8. | Terminalia (Baheda) | belerica | Dr. Rajendra Prasad Road, Barakhamba Road. |
| 9. | Manilkara (Khirni) | hexandra | Maulana Azad Road, Mansingh Road(Part) |
| 10. | Bombax (Semal) | ceiba | Niti Marg, Nyaya Marg |
| 11. | Ailanthus (Maharukh) | excelsa | Copernicus Marg |
| 12. | Madhuca (Mahua) | indica | Rajesh Pilot Marg (South end Road) |
| 13. | Pterygota (Buddha's Coconut) | alata | Bishambhar Das Marg |
| 14. | Gmelina arborea | | B - Avenue, Sarojini Nagar |

| | | | |
|---|---|---|---|
| | (Gamari) | | |
| 15. | Alstonia scholaris (Saptaparni) | | Vinay Marg, Kautilya Marg, Kitchner Road, Safdar Hashmi, Tansen, RK Ashram Marg |
| 16. | Ficus tseila | | Malcha Marg Market |
| 17. | Cassia (Amaltas) | fistula | Chandragupta Marg, Amrita Shergill, Humayun Road |
| 18. | Ficus benghalensis (Bargad) | | Teen Murti Road( Part) |
| 19. | Hardwickia (Anjan) | binata | Pandara Road |
| 20. | Moulsari | | San Martin |
| 21. | Large Mixed Gulmohar, Lagerstroemia thorelli, Polyalthea longifolia | | South Avenue, North avenue, |

# TECHNICAL SPECIFICATION
# FOR
# CONCRETE WORKS

**Plain & Reinforced Cement Concrete**CHAPTER 2 : REINFORCED CONCRETE WORKS

The main components of this chapter are Cement, Steel & Aggregates. Following are the references and practices to be followed during construction. CEMENT : The cement used for PCC/Reinforced concrete works shall be ordinary Portland cement of approved brand and manufacture by the Executive Engineer and shall comply in all respects with Portland cement confirming to I.S. 269-2015. The contractor shall use only one brand of cement for the structural portion of the building, therefore arrangements shall be completed at the time of commencement of work to have a continual supply of that brand from start to finish. Other brands will be acceptable for other phases of work (i.e. plastering, screed, punning), again mixing of different brands cement in phases such as plastering shall not be allowed. Each phase of work shall be limited to a single brand. It shall be delivered to the site in packages (bags) with an unbroken seal fixed by the makers and plainly marked with the name of the brand and the date of manufacture. The contractor shall weigh the cement bought at site as per the random selection from the Engineer in charge. The weight of the cement shall be 50 kg net and shall be fresh. The cement shall be stored in stacks on raised platforms, dry and impervious to water with at least 300 mm clearance from any wall/floor. The cement shall be in regular piles not exceeding ten bags high and in such a manner that it will be protected from moisture and contamination, consignments received shall be used in the order in which they are received. The stores for the cement shall be inspected and approved by Executive Engineer prior to stacking. Where bulk handling of cement is undertaken protective masks shall be provided fro the workmen. Set cement shall immediately removed from the site and replaced by the contractor at his own expense. If desired, tests shall be made by taking samples cement from stores or elsewhere from the works. The selection of samples and procedure for testing shall comply with the appropriate I.S. codes. Should the contractor deem it necessary or advantageous to use multiple brands, each brand shall be stored in a separate facility to eliminate confusion and inadvertent mixing of brands during the work. Division of a single facility shall not be acceptable, as monitoring becomes difficult. The minimum compressive of ordinary Portland cement shall be as per I.S. 269. The initial setting time should not be less than 30 minutes and the final setting time should not be more than 10 hours. FINE AGGREGATE : The fine aggregate (sand) shall confirm to either I.S. 383-1963 or I.S. 515 up-to-date. It shall be clean, sharp, heavy and gritty to touch. Sand should be free from clay, mica, vegetable and organic matter or any other foreign matter. River and pit sand should be used as this does not contain common salt in large quantities. Sand should be perfectly dry before it is used, otherwise the bulking effect of sand must be taken into account.

Sand must be cleaned by screening before its use. If a sample of sand contains more than 4 to 5 percent of clay, it should be washed thoroughly before use. The percentage of clay lumps shall be determined by examining the various fractions that remain after the material has been tested for grading. Any particles that can be broken with fingers shall be classified as clay lumps and the total percentage of clay limps shall be determined on the basis of the total original weight of the sample. Sand for all cement concrete works must be coarse. It should not pass through I.S. sieve No. 480 (approximately 4.75 mm) and retained on No. 15 sieve (5.5 mm). The fineness modulus of coarse sand shall be determined by taking 500 gms of it from a representative sample of sand and passing it successively through I.S. sieves No. 484, No. 240, No. 120, No. 60, No. 30 and No. 15. Sand used in cement shall be from an approved pit, river sand is not appropriate as the water action on the grains round the edges and reduce the gripping hold of the particle. The pit sand used must be properly washed and free from any kind of mud & clay components. Medium sand may be used in cement mortar for masonry, plastering, pointing etc. and bituminous works of road. Sand filling in plinth, where specified may be done with fine sand. The fineness modulus of fine sand should not be less than one. Fine aggregate shall be

preferably stacked in regular stacks on hard surface of platform so as to prevent the admixture of clay, vegetable and other foreign matter. The contractor shall be using different sieve size sand for the different purposes such as structural and non- structural. It is advised that the contractor maintain a proper storage place for different type of sand, in quality such as sieve sizes, origin etc. This shall be very or advantageous to eliminate confusion and inadvertent mixing during the work. Division of a single facility shall not be acceptable, as monitoring becomes difficult COARSE AGGREGATE : Aggregate, as per IS 383, most of which is retained on 4.75 mm I.S. sieve and containing only so much finer material as is permitted for the various types described below. Quality of Aggregates: Aggregate shall consist of gravel or stone, crushed or uncrushed, or a combination thereof. It shall be hard, strong, dense, durable, clean and free from adherent coatings. As far as possible, flaky and elongated pieces should be avoided. It shall be obtained from approved quarry. Deleterious Materials: Aggregate shall not contain any harmful material, such as coal, mica, laminated material, clay, alkali, soft fragments, sea-shells, organic impurities etc, in such quantity as affect the strength or durability of the concrete or in addition to the above for reinforced concrete, any materials which might affect the reinforcement. Aggregates which are chemically reactive with the alkalies or cement are harmful, as cracking of concrete may take place.

1.Mechanical Properties of Aggregate: The aggregate crushing value, when determined in accordance with I.S. 2386 (Part IV), mechanical properties shall not exceed 45 per cent for aggregate used for concrete other than for wearing surfaces and 30 percent for concrete for wearing surfaces such as runways, roads and pavements.

2. Size and Grading of Aggregate: When coarse aggregate brought to the site is ungraded, single size coarse aggregates of different nominal sizes, confirming to the requirements vide, table given below, shall be mixed at site. Ungraded materials shall not be placed on site, unless pre-approval is issued by the field engineer. Any such materials brought to the site shall be placed in a segregated area, so that their accidental incorporation in cement does not happen.

| Designation | All in aggregate grading Percentage passing 40 mm nominal size | 20 mm nominal size |
|---|---|---|
| 80 mm | 100 | |
| 40 mm | - 95-100 | 100 |
| 20 mm | 45-75 | 95-100 |
| 4.75 mm | 25-45 | 30-50 |
| 600 micron | 8-30 | 10-35 |
| 150 micron | 0-6 | 0-6 |

1. Storage: The contractor shall provide means of storing the aggregates at each point where the concrete is such that (a) each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times (b) contamination of the aggregates by the ground or other foreign matter shall be effectively prevented at all times and (c) each heap of aggregate shall be capable of freely being drained. The contractor shall ensure that the graded coarse aggregates are tipped, stored and removed from the stock yard in manner that does not cause segregation. The contractor shall make

available to the Engineer incharge such samples of aggregates, as required. Such samples shall be collected at the point of discharge of the aggregate to the batching plant. If any such sample doesn't confirm with the specification, the aggregate it represent shall be promptly removed from the site and the contractor shall carry out such modification to the storage arrangements as may be necessary to secure compliance with the specification. STEEL : The reinforcement shall be of mild steel and medium steel wire, conforming to I.S. 432-1960 or TMT bars conforming to I.S. 1786-2008 or deformed steel bars conforming to I.S.1139 with up-to-date modification. Bar reinforcement described as "mild steel" shall be plain round hot rolled steel bars. Bar reinforcement described as "tor steel shall be hot rolled deformed bars or

7.0 cold twisted bras or Fe500. With respect to manufacture, quality, physical properties and related requirements, reinforcement bars of the foregoing description shall comply with appropriate parts of IS Standards 432 (part I). All reinforcement shall be clean and free from loose mill scales, dust and coats of paint, oil, rust or other coatings which may destroy or reduce bond. The steel bar shall be found and capable of being bent (doubled over) without fracture. Joint in the bars should be avoided as far as possible, when joints have to be made an overlap of 45-60 times diameter of the bar shall be given with proper hooks at ends and joints should be staggered. CEMENT CONCRETE WORKS Materials: All the materials used in the cement concrete such as cement, sand (fine aggregate), coarse aggregate, water, and reinforcement shall be as per the relevant I.S. Codes and/or as per the individual specification presented. Proportion: The proportion of the concrete shall be as mentioned in the Bill of Quantities, Working Drawings etc. The minimum compressive strength for the cement concrete shall be in accordance with I.S. 456-upto date revision. The aggregates, both coarse and fine shall be measured by volume with boxes. Cement need not be measured by box; one bag of cement (50 kg) should be considered. Size of measuring box may be 30 cm x 30 cm x 38 cm or equivalent volume. All materials shall be dry, if damp sand is used, compensation shall be made by adding additional sand to the extent required for the bulking of damp sand. Mixing shall be of machine mixing. For small works hand mixing by batches may be allowed but about 10% extra cement need to be added as per the compensation. Work shall be planned to minimize hand mixing, Hand mixing shall be limited to minor repair works and incidental occasions. A box shall be kept on site with the capacity of 10% of a sack of cement (5kg) and used any time hand mixing is being done to meet the requirements for hand mixing. Besides that, for the first batch of mixing for the day, an extra bag of cement is added to the first mix. It is assumed that this shall compensate all the cement being connected to the equipments such as mixture machines, batching trolleys etc. 1. Machine mixing: The mixer drum shall be flushed clean with water. Measured quantity of dry coarse aggregate shall be place first; this shall be followed with measured quantity of fine aggregates and then cement. Aggregates, sand and cement shall be put into the cement concrete mixer to have required proportion as per the Bill of Quantities, working Drawings, etc. The machine shall then be revolved to mix materials dry and then water shall be added gradually to the required quantity, 20 to 28 litres, per bag of cement to have the required water cement ratio. The mixing should be thorough to have plastic mix of uniform colour. It requires 11/2 to 2 minutes' revolution for thorough mixing. Mixed concrete shall be unloaded on a masonry platform or on a metal sheet. Output of concrete mixer shall be approximately 15-20 batches per hour. Approximate quantity by

water required for cement concrete may be taken 30% by weight of cement plus 5% by weight of total aggregate. The concrete compacted by mechanical vibrators the quantity of water shall be reduced by 20%. 2. Slump: Regular slump test should be carried out to control the addition of water and to maintain the required consistency. A slump of 7.5 cm to 10 cm may be allowed for the building. Slump tests shall be done on a regular basis during batching and placing of concrete, or as directed by the Executive Engineer. 3. Formwork: Formwork, centering and shuttering, shall be provided as required, as per standard specifications as per IS 1200 Part V, before lying concrete confine, to support or to keep the concrete in position. The inner surface of the shuttering shall be oiled to prevent concrete sticking to it. The base and formwork over which concrete to be laid shall be wetted by sprinkling water before the concrete is laid. Forms shall be removed as specified. Formwork shall be removed slowly and carefully without disturbing and damaging concrete. Upon removal of forms any minor voids shall be repaired immediately, deeper voids (min. 12mm to max 25mm) shall have a proper patch administered as per the instruction of the Executive Engineer, to seal and protect the reinforcement. 4. Laying: Concrete work shall be started until written permission from the Executive Engineer is not issued to the contractor. Concrete shall be laid gently (not thrown) in layers not exceeding 15 cm and compacted with mechanical vibrating machine until dense concrete is obtained. Over-vibration which will separate coarse aggregate from concrete should be avoided. After removal of the formwork in due time, the concrete surface shall be free from honey combing, air holes or any other defect. The contractor need to use vibrator as per the recommendation of the consultant no matter what the volume of the concrete for a day shall be done. Concrete shall be laid continuously, if laying is suspended for rest or for the following day, the end shall be sloped at an angel of 300 and made rough for future jointing. When the work is resumed, the previous sloped portion shall be roughened, cleaned and watered and a grout of neat cement (thick cement slurry) shall be applied and fresh concrete shall be laid. For successive layer the upper layer shall be laid before the lower layer has set. Every effort shall be made to minimize “cold”/ construction joints, work shall be planned and reviewed with the site engineer prior to commencing and the contractor shall be prepared to extend the labour and site supervision to accomplish pouring in such a fashion. For the special areas where mentioned in the sanctioned drawings, where there shall be not further finishing, the contractor shall to take further precautions such as is required to finish in compliance with the drawings and clients wishes, or as specified by Executive Enigneer, without any additional cost. The contractor’s failure to comply with the Executive Engineers stated expectation of finishing shall open themselves to having the pour rejected and loss of payment or removal and replacement in compliance with the finish required. Neat cement punning on the surface is not an option for consideration. It is highly recommended that the contractor to use power trowels in the area of basement where there is no other finishes. This shall assist the work to be completed in faster rate and in satisfaction to the client’s expectation. The contractor shall manage his staff and materials to guaranty compliance with the approved schedule and amount of work to be accomplished on a daily basis, yet maintaining the desired quality. In the specified areas such as ramp, external courtyard, etc., the contractor shall at completion of the concrete placement begin the finishing process which shall at completion

render a "broom finish". The specific broom need to be utilized to complete the specified broom finish required by Executive Engineer. "Broom finish" here implies a non-skid concrete surface without application of any kind of additional surface on top of the concrete. The contractor needs to produce the "broom finish" with the application of broom just after the completion of concreting before the concrete is hardened. The contractor may propose alternative methods to accomplish this surface texture, but must receive prior approval from the Eecutive Engineer before commencing the work. 5. Control of Concrete: The contractor shall be called upon to submit representative samples of material to be used for concrete in order that they may be tested at a laboratory and the suitability of materials established. All expenses in connection with the above material tests shall be borne by the contractor. During the progress of the work 15 cm cubes shall be made as per I.S. 456-2000 as necessary and tested in accordance with I.S. 516-reaffirmed 2018. A minimum of three cubes shall come from various batches or individual days. The concrete used in the project, from these batches, shall be recorded and properly maintained. The cubes shall be tested for 7 days, 14 days, and 28 days unless directed by Executive Engineer. The testing results shall meet the minimum compressive strength mentioned in the structural drawings or specified by the IS Code standard so that the field concrete work has the strength required as per the code or standard for stipulated time period, i.e. for concrete work of M20, the strength must be minimum 27 MPa in 28 days. All such testing shall be done in presence of Executive Engineer or his representative. The test result conducted in absence of Executive Engineer or his representative shall not be accepted or deemed valid. 6. Curing: Freshly laid concrete shall be protected from rain by suitable curing. The work should be protected from damage and rain during construction. After about two hours laying, when concrete has begun, to harden, it shall be kept damp by covering with wet gunny bags for 7 days continuously 24 hours. After the 7th day, the contractor needs to make sure that the concrete remains wet during the hot days upto 7 days of casting. If specified curing may be done by covering concrete with special type of waterproof paper so as to prevent water escaping or evaporating. Curing and strength development is an important part of the construction process and failure to maintain the concrete as per the stated parameters shall result in rejection and loss of time. As no time extension shall be administered for removal and replacement of any rejected work which could have been prevented with proper administration of the contract. Executive Engineer reserves the full right to hold the concreting works if the proper curing management is not performed before the concreting. Executive Engineer holds the total control for curing and has full authority to hold the concreting work using the past curing works as an example. The contractor needs to allocate a separate staff for curing of the concrete for at least 14 days. 7. Repairing Honeycomb: Immediately after stripping the formwork, minor defects and honey combed area shall be patched and the holes filled before the concrete is thoroughly dry. Patch areas shall be chipped away to a 25 mm depth, with regular edges perpendicular to the surface. The contractor needs to mobilize personnel to rectify the honey combing as the formworks are being stripped off the concrete surface. The contractor needs to make necessary arrangement prior to the removal of formwork and needs to complete the work when the concrete is green. Test of Structure: Executive Engineer shall instruct for a proper testing mechanism on the works or any part thereof if in the

opinion such a test be deemed necessary for one or more of the following reasons:  The site-made concrete test cubes failing to attain the specified strength.  The shuttering being prematurely removed.  Concrete improperly cured. If the contractor is instructed to conduct testing of concrete already placed for any of the previously stated reasons it shall be accomplished at his expense. If the member shows evident failure, changes as are necessary to make the structure adequately strong shall be made free of cost. The entire cost of testing shall be borne by the contractor. If in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same shall be made good free of charge by the contractor to the satisfaction of Executive Engineer. If the results of the tests are not satisfaction, executive engineer shall instruct the loading test of the entire structure. If such testing is required by Executive engineer, the member under consideration shall be subjected to a superimposed load equal to one and a quarter (11/4) times the specified superimposed load used for design and this load shall be maintained for a period of 24 hours before removal. The detail procedure of the test is to be decided by Executive Engineer even after these tests the results obtained are not satisfactory to executive engineer, the part of the works concerned shall be taken down or removed and reconstructed to comply with the specification, or that such other remedial measures shall be taken as to make the works secure. The contractor needs to bear all the cost for taking out and other remedial works. 8. Water Proofing Compound: For those areas, such as shear walls of the water tanks, terrace slabs, the contractor needs to mix the water proofing compound of IS, ASTM & BS standards within the concrete itself for the extra protection. The contractor needs to get approval of the specification and the brand of the water proofing compound likely to be used prior to the application. Once the water proofing compound is approved, the contractor needs to apply the mix, proportion as per the manufacturer's specification. The contractor holds full responsibility for the water proofing compound in concrete. FORMWORK Formwork shall be designed and constructed so that concrete can be properly placed and thoroughly compacted. Formwork shall be firmly supported and adequately strutted, braced, or tied. It shall be capable of adjustment to the lines and dimensions of the finished concrete and it shall be sufficiently strong to resist without distortion, the pressure of concrete during its placing and compaction and other loads to which it may be subjected. It shall not be liable to suffer distortion under the influence of the weather. When concrete is to be vibrated, special care shall be taken to ensure that the formwork will remain stable and joints tight, gaps in form panels greater than 5mm shall not be acceptable. The safety and adequacy of centering and shuttering shall be sole responsibility of the contractor. Formwork shall include all forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required for their support. Materials for Formwork: Formwork shall be of minimum 19 mm thick water proof plywood or metallic sheets unless otherwise specified. Timber used for formwork shall be easily workable with nails without splitting and of light weight. It shall be stiff and strong enough to avoid undue deflection when loaded and not liable to warp when exposed to sun and rain or wetted during casting of concrete. Formwork shall be of rigid construction true to shape and dimensions shown on drawings. It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other

incidental loads imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of braces and ties. To make up any settlement in the formwork either before or during the placing of concrete, hard wood wedges shall be provided where required. Error upto 10 mm shall be under tolerance, so the contractor needs to maintain the materials as well as the workmanship upto the perfect expectation. All form work shall be so constructed as to be removable in section in the desired sequence, without damaging the surface of concrete or disturbing other sections. Forms should be easy to strip after connecting and no piece should be keyed into the concrete. The completed form work shall be approved after inspection by Executive Engineer. Propping and Centering: Props used for centering shall be of steel unless otherwise specified. All props shall further be provided with double wedges so as to facilitate tightening and easing of shuttering without causing shock to the concrete. In case a span exceeds 4.5 m and height exceeds 3.5 m suitable horizontal as well as vertical and / or diagonal bracings shall be provided after accounting for all forces including action of wind which may produce lateral forces. In case the height of centering exceeds 3.5 meters, the props may be provided in multi-stages. The detail of splicing the props at each stage shall be as per approved drawing. The vertical props shall be erected in spacing of 750-900 mm centre to centre. The erecting of the props for any structural elements directly on the ground will not be accepted. They shall be erected on wooden beams or any approved base on the ground. The horizontal bracing shall be at a spacing of 1000 mm centre to centre vertically. Before the casting of concrete is started, the props and wedges shall be thoroughly checked to see that there are intact, in line of level, and plumb. While the casting of concrete is in progress, at least one carpenter shall keep a constant watch on the props and take immediate remedial measures, as soon as any of them gets loosened. Shuttering: The shuttering shall be of approved dressed timber of well seasoned boards to give a smooth and even surface and the joints shall not permit leakage of cement grout. The timber shall be free from loose knots, projected nails, splits, adhering grout or other defects that may mar the cement surface of concrete. It shall not be green or wet as to shrink after erection. Species of timber which are not affected appreciably by its contact with water shall be used. When metal forms are used, all bolts and nuts shall be countersunk and well ground to provide a smooth plain surface. Opening for fan clamps and other fittings connected with services shall be provided in the shuttering as directed by Executive Engineer. The surfaces of timber shuttering that would come in contact with concrete shall be thoroughly cleaned and well wetted and coated with soap solution, raw linseed oil, or form oil of approved manufacture, or any other approved material such as polythene sheets, to prevent adhesive of concrete to form work. Executive Engineer shall inspect and accept the form work as to its strength, alignment and general fitness before placing any concrete in the forms. But such inspection shall not relieve the contractor of his responsibility for safety of man, machinery, materials and for results obtained. Suitable camber shall be provided in horizontal members of structures especially in long members to counteract the effects of deflection. The camber for beams and slabs shall be 4 mm per meter i.e. 1 in 250 and for cantilevers, at free end shall be 1/50th of the projected length or as directed by Executive Engineer. In case of beams and shear walls, the shuttering shall be tied with nut bolts system @ 750 mm centre to centre vertically and

horizontally unless instructed by Executive Engineer Off-formfinish: The concrete shall be an off form finish, which means that the formwork itself shall be of a good finish to achieve the off form concrete surface smooth and even, free from all board marks, projections, pits and honey combing etc and all arises shall be square, straight and true. The contractor shall especially see that the finished exposed surface be smooth and even so that no rendering or plastering is required. 2. Removal of Formwork: The formwork shall be removed avoiding shock or vibration that may cause any damage to concrete. In slab and beam construction, sides of beam shall be stripped first; then the under sides of slab and lastly the underside of the beam. The period that shall elapse after the concrete has been laid before undertaking the work of easing and removal of centering and shuttering shall be as per according to I.S. 456-2000 revision. In case of cantilever slabs and beams, the centering shall remain till structures for bearing down have been erected and have sufficient strength. Measurement: Measurement for payment shall be done on the area of which centering shuttering has been carried out. Rate shall include centering and shuttering including propping, strutting etc. and removal of forms, including applying form oil to shuttering. The rate also includes removal of the form as per the specified time. Nothing extra shall be paid for any kind of curved surfaces, small offsets, decorative designs etc. unless otherwise specified. All these decorative designs and offsets shall be measured accordingly as mentioned earlier and no special provision shall be applied to these measurements. The contractor needs to produce off form finish concrete as much as possible. Nothing extra shall be provided to the contractor for this account. The formwork & Concrete combined to be paid for payment as specified

8.0 **7.1 General**

Except where they are varied by the requirements of this specification the provisions of Indian Standard specifications, under IS: 456 – 2000 for plain and reinforced concrete and IS: 1786 for high strength deformed steel bars etc., for concrete reinforcement and other relevant IS applicable together with the latest amendments shall be held to be incorporated in this specification. It shall be the intent of these specifications to ensure that all concrete placed at various locations of the job should be durable, strong enough to carry the design loads, should wear well and practically be impervious to water. It should be free from such defects as shrinkage, cracking and honeycombing.

**7.2 Proportioning the Mix**

In directed by volume batching, controlled concrete, proportions of cement to fine and coarse aggregate shall be as specified in the respective items and shall be accurately measured as in Table 'A' 2.16. These proportions are based on the assumption that the aggregates are dry. If the aggregates are moist, allowance shall also be made for bulking in accordance with IS:2386. Allowance shall also be made for surface water present in aggregate when computing water content. Surface water present shall be determined by one of the field methods described in IS: 2386 (Part – III). In the absence of exact data, the amount of surface water may be estimated from the values given in **Table 'B' 7.16**.

**7.3 Mixing**

Concrete of 1: 2: 4 or richer mix shall be mixed in an approved mechanical mixer. The mixer and mixing platform shall be suitably protected from wind and rain. Aggregates shall be accurately measured out in boxes of approved measures and mixed dry along with cement; water shall then be added in measured quantity and mixing shall be

continued until there is uniform distribution of the materials and the mass is uniform in colour and consistency but in no case shall the mixing be done for less than 2 minutes.

When hand mixing is permitted with the approval of the Engineer, it shall be carried out on a watertight mixing platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. 10% extra cement must be added for hand mix at the cost of Tenderer if permitted for hand mix to obtained proper workability of strength.

**7.4 Consistency**

Quantity of water for making reinforced concrete shall be sufficient to ensure that concrete laid in position shall be surrounded and properly grip all the reinforcement. The best consistency shall be that when the mix flows sluggishly without flattening itself out and without separation of coarse aggregate from the mortar. The degree of plasticity shall depend on the nature of the work and atmospheric temperature and whether the concrete is vibrated or hand compacted. The slumps obtained by the standard slump test carried out in accordance with the procedure laid down in IS: 1199 – 1959 shall be adopted for different types of work.

**7.5 Admixtures**

The use of admixtures such as retarders, super plasticisers, accelerators may be allowed if approved by the structural consultant and his decision in this regard shall be final. In any case, before use admixtures shall be tested for compatibility with design requirements.

**7.6 Other Chemicals**

A large number of concrete chemicals for internal / external application are available and may be deployed on case to case basis, on the approval of the Engineer.

**7.7 Transporting**

Concrete shall be conveyed from the place of mixing to the place of final deposit as rapidly as practicable by methods designed to prevent segregation or loss of any of the ingredients. If segregation does occur during transport, the concrete shall be remixed before being placed in – situ. In no case, more than 30 minutes shall elapses between mixing and consolidation in position.

**7.8 Placing & Compacting**

Concrete shall be placed in layers of suitable thickness or in strips and compacted before initial setting commences and should not be subsequently disturbed. Method of placing shall as far as possible be continuous and be such as to preclude segregation. Special care shall be taken in accordance with IS: 456 while laying concrete under extreme conditions of weather.

Transporting and depositing / placing concrete by pumps or other mechanical means such as buckets, chutes, conveyor, etc. shall be with the approval of the Engineer.

Concrete shall be thoroughly compacted during the operation of placing and thoroughly worked around the reinforcements, embedded fixtures and spaded against corners of the form work by punning, rodding, mechanically vibrating or by any other approved means, taking adequate care to ensure that the layers of reinforcement are not disturbed / displaced. Chairs and supports shall be used in adequate numbers to allow labour to pass and cross without again disturbing / displacing reinforcement. In addition, form work shall be tapped lightly by using wooden mallets at the pouring head. The number and types of vibrators to be used shall be subject to the approval of the Engineer and in general, immersion type vibrators when used shall have the desired amplitude and frequency depending on the mix design, sizes of the members and the gaps between

reinforcing bars. External vibrators such as shutter or screed vibrators shall also be used whenever so directed.

The intensity and duration of vibration shall be sufficient to cause complete settlement and compaction without any stratification of successive layers or separation of ingredients or formation of laitance. Vibrator shall be inserted vertically in the concrete at points not more than 45cm apart and withdrawn very slowly when air bubbles no longer come on the surface. Over vibration or vibration of very wet mixes is harmful and should be avoided. Care shall be taken to utilise the vibrator only to compact the concrete and not to spread it. Sufficient number of reserve vibrators in good working condition shall be kept on hand at all times, so to ensure that there is no slackening or interruption in compacting.

## 7.9 Controlled Concrete

### 7.9.1 Mix Design

Where controlled concrete is specified the mix shall be designed to produce the grade of concrete with the required workability and characteristic strength not less than the appropriate value for each grade specified in IS: 456 – 2000. The procedure for the design shall be as prescribed in IS Code No.: 10262.

### 7.9.2 Design Mix concrete

The mix shall be designed to produce the grade of concrete. Having the required workability and characteristic strength not less than appropriate values given in the relevant specifications.
As long as the quality of materials does not change, a mix design done earlier, shall be considered adequate for later work. However, incase the quality of materials change, the Engineer may ask for a new design mix.

While designing the mix, the durability requirements as given in IS: 456 shall also be taken into account. However, the minimum specified cement content for concrete shall be:

M15 300

M20 320

M25 360

M30 400

Using 43 / 53 grade OPC unless specified in the item of work. 43 / 53 grade OPC (IS:8119) shall be used in all RCC works above ground level. PPC is preferred for use in masonry and plaster and for all works below ground level including in RCC: Unit cement content remaining at minimum indicated.

Method of measurement unless otherwise stated in specification, shall be based on relevant IS specifications. Items of work / materials specific to the locality shall be governed by the local PWD practices, unless it is explicit in tender documents.

### 7.9.3 Concrete Technologist

When in any work the quantity of all concrete in reinforced cement concrete work is 400 cum. or more, the Tenderer shall engage a qualified and competent concrete technologist / consultant whose name shall be got approved by the Engineer, whose duty

shall be to supervise the reinforced cement concrete work right from the time, before commencement of the work, sampling of aggregate is done for designing mixes to the time when all tests **ON CONCRETE WORKS ARE COMPLETED**. In other cases there shall be at the site a qualified Civil Engineer to carry out the work of the concrete technologist.

**7.9.4 Testing Laboratory**

When similarly the quantity of all concrete in RCC work is 800 cum. or more, the Tenderer shall establish a laboratory of his own at the site with all equipment, instruments and accessories and personnel necessary to carry out designing and testing concrete. In other cases the Tenderer shall get the designing – testing work done at approved laboratories in the city.

**7.9.5 Proportions**

It is the Tenderer's responsibility to have the necessary tests carried out at his cost, in his own laboratory and the necessary calculations made, in accordance with IS : 10262 to arrive at the best proportion by weight of aggregate and cement to produce concrete of the desired strength, submit the details to the Engineer and shall be called the declared Proportions. If the proposal made by the Tenderer is not satisfactory to the Engineer the test and calculations shall be redone by the Tenderer, at his cost, under the guidance of the Engineer and fresh proportions established with the approval of the Engineer. The minimum quantity of cement to be consumed shall as prescribed in IS code and in cases of short use of cement the Engineer have the option to reject the concrete when the Tenderer shall remove and replace the concrete to specification or accept the concrete with the provisions and the conditions of contract operative. No deviation from declared proportions will be allowed without written authority from the Engineer. The declared proportion may be altered to suit substantial variations in the quality of the aggregates collected at site, from time to time and every time an alteration becomes necessary the test and calculations shall be repeated. No approval for and no agreement to any declared proportion, by the Engineer or other person shall relieve the Tenderer of his responsibility to produce in situ concrete of the desired quality and strength in accordance with the relevant IS Code.

**7.9.6 Measurements of Ingredients**

Proportioning of the ingredients for each batch of concrete shall be carried out in an approved weigh batching machine, water being fed into the mixer from a calibrated tank provided with the means of adjusting the flow, due allowance being made for the weight of water carried by the coarse and fine aggregate, which shall be periodically ascertained.

When the quantity of all concrete in reinforced cement concrete work is less than 400 cum. alternatively, the declared weight proportions may with the approval of the Engineer be converted into equivalent volumetric proportion and mixing may be done in the usual manner adopted for nominal mixes.

**7.9.7 Mixing, Transporting, Depositing, Compaction, Curing, etc.**

The specifications shall be as for concrete, plain and reinforced earlier described. No concrete for RCC work shall be placed in position unless written authorization is obtained from the Engineer. For all design mix concreting, mixing of concrete shall be done using weigh batching system.

**7.9.8 Construction Joints**

Concreting shall be carried out end to end continuously as far as possible and when construction joints are totally unavoidable, they shall be located in predetermined positions approved by the Engineer. The joints shall be kept at places where the shear force is the minimum and shall be straight and at right angles to the direction of main

reinforcement. When the work is to be resumed on a surface, which has hardened, such surface shall be roughened, swept clean, thoroughly wetted and covered with a 13mm thick layer of mortar composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This 13mm layer of mortar shall be freshly mixed and placed immediately before the placing of fresh concrete.

Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristly brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and free water removed and then be coated with neat cement grout. In horizontal joints the first layer of fresh concrete to be placed on this surface shall not exceed 15cm thickness and shall be well rammed against the old work, particular attention being paid to corners.

**7.9.9 Expansion Joints**

Expansion joints shall be provided where required as shown on the drawings or as directed by the Engineer / Consultant. The joints shall be filled in with filler of approved quality and type.

**7.10 Curing**

Concrete shall be carefully protected during the first stage of hardening, from harmful effects of excessive heat, dry winds, rain or running water. It shall be covered with a layer of sacking, sand, canvas, hessian or similar absorbent material and kept constantly wet for ten days from the date of placing of concrete, alternatively the concrete being thoroughly wetted and covered by a layer of approved waterproof material which should be kept in contact with it, for seven days.

In the event curing by water is inefficient / ineffective the Engineer may permit / may also enforce curing, on release of form work, by application of chemical sealants, but no extra charges are payable.

**7.11 Form Work**

Form work shall include all temporary or permanent forms or moulds required for forming the concrete in situ together with all temporary construction required for their support. Form work shall conform to the shape, lines and dimensions as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete and shall be sufficiently watertight to prevent loss of cement slurry from the concrete. Form work or centering shall be constructed of steel or timber, aluminex, FRP, Polypropylene, etc. adequately designed to support the full weight of wet concrete without deflection and retain its form during laying, ramming and the setting of concrete. Timber used shall be of properly seasoned quality to avoid deformation when wetted.

All props shall be straight and of full height and no joints shall be permitted. Props, if in timber, shall be tied and braced with thin casurina post and or wooden battens and where additional staging is necessary care shall be taken to use props of bigger diameter with bracings at 4 or 5 levels. All props shall be supported on sole plates and double wedges. At the time of removing props these wedges shall be gently eased and not knocked out.

Proprietary systems of form work and scaffolding may also be deployed in which case manufacturers' instructions on erection, bracing and removal shall be strictly followed.

Forms shall be so constructed as to be removable in sections on designed sequence, without damaging the surface of concrete or disturbing other sections. Form work must be the case of complicated structures and / or on spans of more than 12m, the details of form work shall be properly worked out by the Tenderer and the scheme, setting and release, shall be got approved by the Engineer, well in advance before concrete work is to be taken up. All rubbish, chippings, shavings and saw dust shall be removed from the interior of the forms before the concrete is placed and the form work in contact with the concrete shall be cleaned and thoroughly wetted or treated with non – staining mineral

oil or any other approved material. Care shall be taken to see that oil or similar other such approved material is kept out of contact with the reinforcement.

All form work shall be removed without shock or vibration and shall be cased off carefully in order to allow the structure to take up its load gradually. Forms shall not be disturbed until concrete has adequately hardened to be able to take the superimposed load coming on it and in no circumstances shall forms be struck until the concrete reaches a strength of at least twice the stress to which the concrete may be subject to, at the time of striking. In the normal circumstances (generally where temperatures are above $21^0$C) and where ordinary cement is used, forms may be struck after expiry of the following periods:

| | | |
|---|---|---|
| (a) | Walls, columns and Vertical sides of beams | 48 hours or as may be directed by Engineer. |
| (b) | Bottom of slabs upto 4.5m span | 7 days |
| (c) | Bottom of slab of above 4.5m span, bottom of beam and arch rib upto 6m, span | 14 days |
| (d) | Bottom of beams and arch rib over 6m span. (or as revised in IS: 456 – 2000) | 21 days |

However, this period may be increased or decreased at the discretion of Engineer. Special care shall be taken while striking the centering of cantilevered slabs, canopies, portal frames, folded plate construction, for which period for striking, centering shall be as determined by the Engineer.

If directed, forms shall be given an upward camber to ensure that the beams do not show any sag. Surfaces that become exposed on removal of forms shall be carefully examined and any fins, burrs, projection, etc. that there detected shall be removed. Honeycombing of minor nature, over limited areas may be finished neatly with cement mortar 1:2 only on being so permitted and as directed by the Engineer.

Any work showing signs of damage through premature or careless removal of centering or shuttering, shall be reconstructed by the Tenderer at his own cost. In any case, no concrete work shall be finished, plastered or made good ("touched up" as it is loosely called) in any form unless and until the Engineer inspect and pass the surface for such finishing, plastering or making good.

### 7.12 Strength

Normal Concrete mixed in the proportions desired shall have compressive strengths after placing, of not less than the following.

| Sl. No. | Concrete (Mix Nominal) | Minimum Compressive Strength at 7 days | Minimum Compressive Strength at 28days |
|---|---|---|---|
| 1. | 1:1:2 | 175Kg / Sqcm. | 250Kg / Sqcm. |
| 2. | 1:1 ½:3 | 140kg / Sqcm. | 200Kg / Sqcm. |
| 3. | 1:2:4 | 105Kg / Sqcm. | 150kg / Sqcm. |

### 7.13 Tests

Tests on concrete shall be carried out in accordance with IS: 456 and other IS applicable. The frequency of works test shall be such as may be ordered by the Engineer and subject to such orders, for every 150 cum. a batch of 6 cubes shall be made for every sample and 3 of them tested after 7 days and the remaining cubes after 28 days. The criteria for acceptance of concrete as conforming to the specified proportion / grade of concrete shall be in accordance with IS: 456 and the Tenderer shall entirely re – do rejected work at his

own cost. Strength on 28 days shall alone be considered for acceptance. The Tenderer shall arrange to carry out the tests in accordance with the relevant Indian Standard specifications in an approved laboratory and the test reports in original submitted to Engineer. The entire cost of testing shall be borne by the Tenderer.

**7.14 Steel Reinforcement**

Reinforcement shall be accurately fabricated, placed and adequately maintained in position as shown on drawings or as directed by the Engineer. All finished bars shall be free from cracks, surface flaws, laminations, jagged and imperfect edges. Cement mortar blocks adequately compacted and as dense as the parent concrete holding them and well cured shall be used to give requisite cover as shown on the drawing or as directed and all intersections of bars shall be firmly tied with binding wire of 18 gauge double strand. Commercially available plastic or other cover blocks may also be used. Reinforcement shall be bent in accordance with the procedure stipulated in IS: 2502 – 1963 and will not be straightened in such manner that will injure the material.

All reinforcement shall immediately before placing in concrete, be thoroughly cleaned of loose mill scale, loose rust, oil and grease or other deleterious matter that would destroy or reduce bond. Reinforcement in reinforced concrete members shall not be connected by welding or coupling except in accordance with the relevant IS and with the previous approval of the Engineer. Cold worked HYSD bars shall not be welded at random even for tack unless approved by the Engineer. Overlaps and joints shall be staggered and located at points along the span where neither shear nor bending moment is maximum.

Bars and rods projecting out of concrete and exposed to weather shall, unless completely enclosed / covered by virtue of suitable provision in the schedule of quantities, be protected, free of any charge, by a thick coat of cement slurry .

**7.15 Cover**

Reinforcement shall have cover as shown on the RCC drawings and where not specified the thickness of cover shall be as follows.

a) At each end of reinforcing bar not less than 25mm nor less than twice the diameter of such rod or bar.
b) For a longitudinal reinforcing bar in a column not less than 40mm, nor less than the diameter of such rod or bar. In the case of columns of minimum dimension of 20cm or under, whose reinforcing bars do not exceed 13mm, the cover of 25mm may be adopted.
c) For longitudinal reinforcing bar in a beam, not less than 25mm, nor less than the diameter of such rod or bar.
d) For tensile, compressive, shear or other reinforcement in a slab, not less than 13mm nor less than the diameter of such reinforcement and
e) For any other reinforcement, not less than 13mm nor less than the diameter of such reinforcement. (For Cover blocks see earlier).

**7.16 TABLE `A' (For nominal mix)**

| Nominal Mix | Qty. of Aggregate required for 50 Kg of cement in cum. | | Qty. of Water required for 50 Kg of cement | |
|---|---|---|---|---|
| | Fine | Coarse | Vibrated | Un-Vibrated |
| | | | (For Dry Aggregates) | |
| 1:1:2 | 0.035 | 0.070 | 22 Ltr. | 27 Ltr. |
| 1:1 ½ : 3 | 0.052 | 0.106 | 23 Ltr. | 30 Ltr. |
| 1:2:4 | 0.070 | 0.138 | 27 Ltr. | 32 Ltr. |
| 1:3:6 | 0.105 | 0.210 | 28 Ltr. | 34 Ltr. |
| 1:4:8 | 0.150 | 0.280 | - | 45 Ltr. |

**TABLE `B'**

| Aggregate | Approximate Qty. of Surface Water in Ltr. / cum. |
|---|---|
| Very Wet Sand | 120 |
| Moderately Wet Sand | 80 |
| Moist Sand | 40 |
| Moist Gravel or Crushed Rock | 20 to 40 |
| Coarser the aggregate, lesser the water it will carry | |

**TABLE `C'**

| **Type of Work** | **Slumps** | |
|---|---|---|
| | When Vibrated | When Not Vibrated |
| Mass Concrete in RCC Foundation, Retaining Walls and Road Slabs. | 2.5 cm. | 5 cm. |
| Beams, Slabs, Columns with simple reinforcement | 2.3 cm. to 5 cm. | 5 cm. to 10 cm. |
| Thin Sections with congested reinforcement | 5 cm. to 10 cm. | 10 cm. to 15 cm. |

**Note** : Should conditions governing slump and workability point to advisability of an increased slump, the change shall only be done by decreasing the amount of aggregate and not by increasing the amount of water.

### 7.17 Precast Concrete Jali

a) The jelly shall be of specified grade reinforced with 1.6mm mild steel wire unless otherwise specified.
b) Fixing: The jali shall be set in position true to plumb and level before joints sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement :3 coarse sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jail uniformly on all sides.
c) Measurements: the jail shall be measured for its gross superficial area. The length and breath shall not be less than that specified.
d) Rate: The rate shall be inclusive of materials and labour involved in all the operations described above except plastering of jambs, sills and soffits, which will be paid for under relevant items of plastering.

### 7.18 Precast Concrete

Precast concrete shall comply with IS: 456 and with the following requirements.

a. All precast units shall be cast on suitable bed or platform with firm foundation and free from wind. The Tenderer shall be responsible for the accuracy of the level or shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.
b. Side shutters shall not be struck in less than 24 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches a strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.
c. The lifting and removal of precast units shall be undertaken without causing shock, vibration or undue bending stresses to or in the units. Before lifting and removal takes place Tenderer shall satisfy Engineer or his representative that the methods he proposes to adopt for these operations shall not over stress or otherwise affect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.

d. All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during ;that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits, otherwise curing practice shall be followed.

e. Slots, openings or holes, pockets, etc. shall be provided in the concrete work in the drawings or as directed by Engineer. Any deviation from the approved drawings shall be made good by the Tenderer at his own expense. Without damaging any other work sleeves, bolts, inserts, etc. shall also be provided in concrete work where so specified..

# TECHNICAL SPECIFICATION FOR MASONRY WORKS

**8.0 Masonry Works**

**8.1 Brick Masonry Works**

**8.1.1 Scope**

This specification establishes the materials, dressing, laying, joining, curing, workmanship, etc. for brick masonry works. Brick masonry shall also comply with all the requirements of IS: 2212.

**8.1.2 General Requirements**

**8.1.2.1 Materials:** Refer materials specification in Clause No. 2.0.

**8.1.2.2 Cement Mortar**

Cement mortar shall meet the requirements of IS: 2250 and shall be prepared by mixing cement and sand by volume. Proportion of cement and sand shall be 1:6 (1 part of cement and 6 parts of sand), or as directed by the Engineer / shown on the drawing, for brick masonry of one brick thickness or more, while 1:4 cement mortar (1 part of cement and 4 parts of sand) shall be used for brick masonry of half brick thickness. The sand being used for mortar shall be sieved. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement after water is added to the dry mixture. Mortar unused for more than initial setting of cement, shall be rejected and removed from the site of work.

**8.1.2.3 Proportioning**

The unit of measurement for cement shall be a bag of cement weighing 50 kg. and this shall be taken as 0.035 cum. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage.

**8.1.2.4 Mixing**

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Engineer may, however, permit hand – mixing as a special case, taking into account the magnitude nature and location of work. The Tenderer shall take the prior permission of Engineer, in writing, for using hand – mixing before the commencement of work.

**8.1.2.5 Mixing in Mechanical Mixer**

Cement and Sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually and wet mixing continued for at least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be at least 150 mm above the leveled ground to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend at least 300mm all round the loaded wet mix area. Wet mix, so prepared, shall be utilised within initial setting time [thirty (30)

minutes] for ordinary portland cement conforming to IS: 269 after addition of water. Mixer shall be cleaned with water each time before suspending the work.

**8.1.2.6 Hand Mixing**

The measured quantity of sand shall be levelled on a clean water – tight masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry up being turned over and over, backward and forward, several times till the mix is of uniform colour. The quantity of dry mix which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

**8.1.3 Construction Procedure**

**8.1.3.1 Soaking of Bricks**

i. Bricks shall be soaked in water before use for a period that is sufficient for the water to just penetrate the whole depth of bricks as well as to remove dirt, dust and sand. Proper soaking of bricks shall prevent the suction of water from the wet mortar as otherwise mortar will dry out soon and crumble before attaining any strength. The bricks shall not be too wet at the time of use as they are likely to slip on mortar bed and there will be difficulty in achieving the plumbness of wall as well as proper adhesion of bricks to mortar.

ii. The period of soaking shall be determined at site by a field test by immersing the bricks in water for different periods and then breaking the bricks to find the extent of water penetration. The least period that corresponds to complete soaking, will be the one, to be allowed for in the construction work.

iii. The soaked bricks shall be removed from the tank, sufficient early, so that at the time of laying, they are skin dry. The soaked bricks shall be stacked over a clean place, wooden planks or masonry platforms to avoid earth, dirt being smeared on them.

**8.1.3.2 Laying**

**i. Brick Work (One or more brick thickness)**

a. Brick work (One or more brick thickness) shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. In no case the defective bricks shall be used.

b. A layer of average thickness of 10mm of cement mortar shall be spread on full width over a suitable length of lower course or the concrete surface. In order to check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the brick plus 30mm. Each brick with frog upward, shall be properly bedded and set in position by gently tapping with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. After completion of the course, all vertical joints shall be filled from top with mortar.

c. All brick courses shall be taken up truly plumb, if battered is to be truly maintained. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. The level and vertical work in walls shall be checked up at every one metre interval.

d. The masonry walls of structures shall be carried up progressively, leaving no part one metre lower than the other. If this cannot be adhered to, the brick work shall be raked back according to bond (and not left toothed) at an angle not more than 45 degrees but racking back shall not start within 60 centimeters of a corner. In all cases returns, buttresses, counter forts, pillars, etc. shall be built up carefully

course by course, and properly bonded with the main walls. The brick work shall be raised not more than fourteen (14) courses per day.

e. At the junction of any two walls, the bricks shall at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

f. The courses at the top of plinth and sills, at the top of the wall just below the soffit of the roof beam and at the top of the parapet, shall be laid with bricks on edge. Brick on edge course shall be so arranged as to tightly fit under the soffit of the roof beam or roof slab, restricting the mortar layer thickness upto 12mm, however, any gap between the finished brick work and soffit of roof slab / beam shall be suitably sealed with manhole of 13cm wide of approved quality leaving the equal gap on either side and then sealed with the mortar over chicken mesh as instructed by Engineer.

**ii. Brick Work (Half brick thickness)**

a. For brick walls of half brick thickness, all courses shall be laid with stretches. Wall shall be reinforced with 2 nos. of 6mm diameter mild steel reinforcement bars, shall be straightened and thoroughly cleaned. Half the mortar thickness for the bedding joint shall be laid first and mild steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement covering it fully.

b. The reinforcement bars shall be carried at least 150 mm into the adjoining walls or RCC columns. In case the adjoining wall being of half brick thickness, the length of bars shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6mm dia M.S. reinforcing bar shall be placed at every fourth course of brick masonry. At the junction of two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brick masonry work shall not be raised more than 14 courses per day.

c. Brick course under the soffit of beam or slab, shall be laid by restricting the mortar thickness to 12 mm. However, any gap between the finished brick work and soffits of slab / beam, shall be suitably sealed with the thermocol of 8cm wide of approved quality leaving the equal gap on either side and then sealed with the mortar over chicken mesh as instructed by Engineer.

**iii. Circular Brick Work**

a. The detailed specification for brick work covered under **Clause No. 3.1.4.1** and **3.1.4.2** shall apply, in so far as these are applicable. Bricks forming skew backs, shall be dressed or cut so as to give proper radical bearing. Defects in dressing of brick shall not be covered up by extravagant use of mortar, nor shall the use of chips, etc. be permitted.

b. The circular brick work shall be carried up from both ends simultaneously and keyed in the centre. The bricks shall be flushed with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full or mortar and thickness of joints shall be between 5 mm and 15mm.

**8.1.3.3 Jointing**

Joints shall be restricted to a width of 10mm with brickwork of any classification. All bed joints shall be normal to the pressure upon them i.e. horizontal in vertical walls, radial in circular brick masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In

case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in face which are to be plastered or pointed shall be squarely raked out to a depth of 12mm while the mortar is still green. The rake joints shall be brushed to remove loose particles. After the day's work, the faces of brick work shall be cleaned on the same day with wire brush and all mortar droppings removed.

**8.1.3.4 Curing**

Green work shall be protected from rain or any other running water or accumulated water from any source, by suitable means. Masonry work, as it progresses, shall be kept thoroughly wet by sprinkling water at regular intervals, on all faces. Curing shall be done after 24 hours of completion of day's work and shall be done for at least 10 days after completion. Proper watering cans with spray nozzles, rubber or PVC pipes shall be used for this purpose.

**8.1.3.5 Staging / Scaffolding**

i. Staging / Scaffolding shall be properly planned and designed by the Tenderer. Use of only steel tubes is permitted for staging / scaffolding. Design of staging / scaffolding shall be submitted for approval of the Engineer, before commencement of work.

ii. Single scaffolding having one set of vertical support, shall be used and other end of the horizontal scaffolding member shall rest in a hole provided in the headed course. The support shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with plain cement concrete of grade 1:3:6 during plastering. Suitable access shall be provided to the working platform area. The scaffolding shall be strong enough to withstand all loads likely to come upon it and shall also meet the requirements specified in IS: 2750.

iii. Double scaffolding shall be provided for pillars less than one metre in width or for the first class masonry or for a building having more than two storeys.

iv. The following measures shall also be considered during erection of the scaffolding / staging.

a) Sufficient sills or underpinnings, in addition to base plates, shall be provided, particularly, where scaffoldings are erected on soft grounds.
b) Adjustable bases to compensate for uneven ground shall be used.
c) Proper anchoring of the scaffolding / staging at reasonable intervals shall be provided in each direction with the main structure wherever available.
d) Horizontal braces shall be provided to prevent the scaffolding from rocking.
e) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
f) The scaffolding / staging shall be checked at every stage for plumb line.
g) Wherever the scaffolding / staging is found to be out of plumb line, it shall be dismantled and re – erected afresh. Efforts shall not be made to bring it in line with a physical force.
h) All nuts and bolts shall be the clamps / couplings are firmly tightened to avoid slippage.
i) Erection work of a scaffolding / staging , under no circumstance shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of Tenderer's technically qualified Civil Engineer.
j) For smaller works or works in remote areas wooden ballies may be permitted for scaffolding / staging by the Engineer at his sole discretion. The Tenderer must ensure the safety and suitability of such works as described under Clause 8.1.3.5 above.

**8.1.3.6 Embedment of Fixtures**

All fixtures, pipes, conduits, holdfasts of doors and windows etc. required to be built in walls, shall be embedded in plain cement concrete block of grade 1:3:6, at the required positions, as the work proceeds, unless otherwise specified.

**8.1.3.7 Honey Comb Brick Work**

The brick honeycomb work shall be done with specified class of brick, laid in specified mortar. All joints and edges shall be struck flush to give an even surface.

The thickness of the brick honeycomb work shall be half – brick only, unless otherwise specified. Openings shall be equal and alternate with half brick laid with a bearing of 2cm on either side.

**8.1.3.8 Measurements**

The length and height shall be measured correct to a cm. Area shall be calculated in square metre correct to two places of decimal. Honey comb openings shall not be deducted.

**8.2 Stone Masonry**

**8.2.1 Scope**

Stone masonry work shall comply with all the requirements of IS: 1597 Part I (Rubble Stone Masonry) IS: 3620 (Laterite Stone Masonry) IS: 2185 Part I and IS: 2572 (Concrete Block Masonry).

**8.2.2 Rubble stone masonry**

**i. Materials**

Refer specification for Materials vide Clause No. 2.0.

**ii. Cement Mortar**

Refer 8.1.2.2 under Brick Masonry Works.

**iii. Construction Procedure**

All stones shall be wetted before use. Each stone shall be placed close to the stones already laid so that the thickness of the mortar joints at the face is not more than 20mm. Face stones shall be arranged suitably to stagger the vertical joints and long vertical joints shall be avoided. Stones for hearting or interior filling shall be hammered down with wooden mallet into the position firmly bedded in mortar. Chips or sprawls of stones may be used for filing of interstices between the adjacent stones in heartening and these shall not exceed 20% of the quantity of stone masonry. To form a bond between successive courses plum stones projecting vertically by about 15 to 20cm shall be firmly embedded in the heartening at the interval of about one metre in every course. No hollow space shall be left anywhere in the masonry. The masonry work in wall shall be carried up true to plumb or to specified batter. Random rubble masonry shall be brought to the level courses at plinth, window sills, lintel and roof levels. Leveling shall be done with concrete comprising of one part of the mortar as used for masonry and two parts of graded stone aggregate of 20mm nominal size. The masonry in structure shall be carried uniformly. Where the masonry of one part is to be delayed, the work shall be raked back at an angle not steeper than $45^{o}$.

**iv. Bond stones**

Bond or through stones running right through the thickness of walls, shall be provided in walls upto 60cm thick and incase of walls above 60cm thickness, a set of two or more bond stones overlapping each other by at least 15cm shall be provided in a line from face of the wall to the back. For all thickness of such walls, a set of two or

more bond stones overlapping each other by at least 15cm shall be provided. Length of each such bond stone shall not be less than two – third of the thickness of the wall. Where bond stones of suitable lengths are not available precast cement concrete block of 1:3:6 mix (1 cement: 3 coarse sand: 6 graded stone aggregate 20mm nominal size) of cross section not less than 225 Sqcm. and length equal to the thickness of wall shall be used in lieu of bond stones. This shall be applicable only in masonry below ground level and where masonry above ground level is finally required to be plastered.

At least one bond stone or a set of bond stones shall be provided for every 0.5 Sqm. of the area of wall surface. All bond stones shall be marked suitably with paint as directed by the Engineer.

**v. Quoin and Jamb stones**

The quoin and jamb stones shall be of selected stones neatly dressed with hammer or chisel to form the required angle. Quoin stones shall not be less than 0.01 cum in volume. Height of quoins and jamb stones shall not be less than 15cm. Quoins shall be laid header and stretcher alternatively.

**vi. Joints**

Stones shall be so laid that all joints are fully packed with mortar and chips. Face joints shall not be more than 20mm thick. The joints shall be struck flush and finished at the time of laying when plastering or pointing is not to be done. For the surfaces to be plastered or pointed, the joints shall be raked to a minimum depth of 20mm when the mortar is still green.

**vii. Scaffolding**

Single scaffolding having one set of vertical support shall be allowed. The supports shall be sound and strong, tied together by horizontal pieces, over which the scaffolding planks shall be fixed. The inner end of the horizontal scaffolding member may rest in a hole provided in the masonry. Such holes, however, shall not be allowed in pillars under one metre in width or near the skew back of arches. The holes left in masonry work for supporting scaffolding shall be filled and made good with cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate 20mm nominal size).

**viii. Curing**

Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. Incase of masonry with fat lime mortar curing shall commence two days after laying of masonry and shall continue for at least seven days thereafter.

**ix. Protection**

Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damages, mortar dropping and rain during construction.

**x. Measurements**

a) The length, height and thickness shall be measured correct to a cm. The thickness of wall shall be measured at joints excluding the bushing. Only specified dimension shall be allowed, anything extra shall be ignored. Quantity shall be calculated in cubic metre nearest to two places of decimal.

b) The work under the following categories shall be measured separately.

(i) From foundation to plinth level (level one)

- Work in or under water and or liquid mud.
- Work in or under foul positions.

(ii) From plinth level (level one) to top level of Compound wall.

(c ) Neither deduction nor extra payment shall be made for the following.

(i) Ends of dissimilar materials (that is posts, girders, rafters, purlins, trusses, corbels, steps, etc.) upto 0.1 Sqm. in section.

(ii) Openings each upto 0.1 Sqm. in area. In calculating the area of openings, any separate lintels or sills shall be included along with the size of opening but the end portions of the lintels shall be excluded and the extra width or rebated reveals, if any, shall also be excluded.

(iii) Wall plates and bed plates and bearing of chejjas and the like, where the thickness does not exceed 10cm and the bearing does not extend over the full thickness of the wall.

**Note**: The bearing of floor and roof shall be deducted from wall masonry.

(iv) Drain holes and recesses for cement concrete blocks to embed hold fasts for doors, windows, etc.

(v) Building in masonry, iron fixture, pipes upto 300mm dia, hold fasts of doors and windows, etc.

(vi) Forming chases in masonry each upto section of 350 Sqcm. Masonry (excluding fixing brick work) in chimney breasts with smoke of air flues not exceeding 20 Sqcm. (0.20 Sqm.) in sectional area shall be measured as solid and no extra payment shall be made for pargetting and coring such flues. Where flues exceed 20 Sqcm. (0.20 Sqm.) sectional area, deduction shall be made for the same and pargetting and coring flues shall be measured in running metres stating size of flues and paid for separately. Aperture for fire place shall be deducted and no extra payment made for playing of jambs and throating.

(d) Apertures for fire places shall not be deducted and extra labour shall not be measured for splaying of jambs, throating and making arch to support the opening.

e) Square or Rectangular Pillars

These shall be measured as walls, but extra payment shall be allowed for stone work in square or rectangular pillars over the rate for stone work in walls. Rectangular pillar shall mean a detached masonry support rectangular in section, such that its breadth does not exceed two and a half times the thickness.

f) Tapered walls shall be measured net, as per actual dimensions and paid for as other walls.

g) Curved Masonry

Stone masonry curved on plan to a mean radius exceeding 6m shall be measured and included with general stone work. Stone work circular on plan to a mean radius not exceeding 6m shall be measured separately and shall include all cuttings and waste and templates. It shall be measured as the mean length of the wall.

### 8.2.3 Laterite Stone Masonry

#### i. Dressing

Laterite stones shall be hammer dressed into rectangular blocks so that all faces are free from waviness and unevenness, and the edges are true and square. The least thickness / breadth shall be not less than height. The length shall generally be equal to twice the breadth, unless otherwise specified.

#### ii. Laying

The dressed stones shall be laid in regular courses of not less than 15cm height. All courses in the masonry shall be of the same height unless otherwise directed. The stones shall be laid in alternate header stretcher fashion, alternative courses of header and stretchers or in any other suitable fashion as directed. The vertical joints shall break by at least 65mm. No specific corner stones are necessary. Quoin may be provided, where so indicated.

**iii. Joints**

All bed joints shall be truly vertical, the thickness of joints shall not exceed 15mm. Each stone shall be carefully laid in place with joints completely filled with mortar. On faces, where no plastering or pointing is required to be done, the joints shall be struck flush as the work proceeds. In other cases, joints shall be raked square to a minimum depth of 13mm by a racking tool during the progress of work while the mortar is still green.

**iv. Scaffolding, Curing and Protection**

**a. Scaffolding**

Double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

**b. Protection**

Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage, mortar dropping and rain during construction.

**c. Curing**

Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. In case of masonry with fat lime mortar, curing shall commence two days after laying of masonry and shall continue for at least seven days thereafter.

**8.2.4 Hollow and Solid Concrete Block Masonry**

Hollow and Solid Concrete Blocks shall conform to the requirements of IS: 2185 – 1979. Specification for hollow and solid concrete blocks except with regard to the mix of cement concrete and sizes of aggregates which shall be as indicated. Hollow blocks shall be sound, free from cracks, broken edges, honey combing and other defects that would interfere with the proper placing of block or impair the strength or performance of construction.

**i. Dimensions and Tolerances**

Concrete masonry building units shall be made in sizes and shapes to fit different construction needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose and partition block and concrete floor units. Concrete block hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions.

The nominal dimensions of concrete block shall be as follows.

Length 400, 500 or 600mm

Height 200 or 100mm

Width 50, 75, 100, 150, 200, 250 or 300mm

In addition, block shall be manufactured in half lengths of 200, 250 or 300mm to correspond to the full lengths.

The maximum variation in the length of the units shall be not more than ± 5mm and maximum variation in height and width of unit, not more than ± 33mm.

**ii. Classification**

**Hollow (open and closed cavity) concrete blocks**

The hollow (open and closed cavity) concrete blocks shall conform to the following three grades.

a) Grade 'A' – These are used as load bearing units and shall have a minimum block-density of 1500 kg / cum. These shall be manufactured for minimum average compressive strengths of 3.5, 4.5, 5.5 and 7.0 N / Sqmm. respectively at 28 days (See Table 1).

b) Grade 'B' – These are also used as load bearing units and shall have a block density less than 1500 kg / cum. but not less than 1000 kg / cum. These shall be manufactured for minimum average compressive strengths of 2.0, 3.0 and 5.0 N / Sqmm. respectively at 28 days (See Table 1).

c) Grade 'C' – These are used as non – load bearings units and shall have a block density less than 1500 kg / cum. but not less than 1000 kg / cum. These shall be manufactured for minimum average compressive strength of 1.5 N / Sqmm. at 28 days (see Table 1).

d) Grade 'D' – The solid concrete blocks are used as load bearing units and shall have a block density not less than 1800 kg / cum. These shall be manufactured for minimum average compressive strengths of 4.0 and 5.0 N / Sqmm. respectively ( See Table 1).

**iii. Physical requirements**

Compressive Strength – The average crushing strength of eight blocks, when determined in accordance with IS: 2185 – 1979 shall be not less than as specified in table given below:

**Table – 1**
**PHYSICAL REQUIREMENTS**

| Type | Grade | Density of Block Kg / mm³ | Minimum Average Compressive Strength of Units N / mm² | Minimum strength of individual units N / mm² |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| Hollow (Open and closed cavity) Load Bearing Unit | A (3.5) | Not Less Than 1500 | 3.5 | 2.8 |
| | A (4.5) | | 4.5 | 3.6 |
| | A (5.5) | | 5.5 | 4.4 |
| | A (7.0) | | 7.0 | 5.6 |
| | B (2.0) | Not less than 1500 but not less than 1000 | 2.0 | 1.6 |
| | B (3.0) | | 3.0 | 2.4 |
| | B (5.0) | | 5.0 | 4.0 |
| Hollow (Open and closed cavity non load bearing units. | C (1.5) | Less than 1500 but not less than 1000 | 1.5 | 1.2 |
| Solid Load | D (5.0) | Not less than | 5.0 | 4.0 |

| | | | | |
|---|---|---|---|---|
| **Bearing Units** | **D (4.0)** | **1800** | **4.0** | **3.2** |

a. Drying Shrinkage – The drying shrinkage of the blocks (average of three blocks) when unrestrained, shall be determined in accordance with IS: 2185 – 1979 and shall not exceed 0.1%.

b. Moisture movement – The moisture movement (average of three blocks) when determined in the manner described in IS: 2185 – 1979, shall not exceed 0.09%.

c. Water Absorption – The water absorption (average of three blocks) when determined in the manner described in IS: 2185 – 1979 shall be not more than 10% by mass.

d. Face shells and webs shall increase in thickness from the bottom to the top of the unit. Depending upon the core moulds used, the face shells and webs shall be flared and tapered or straight tapered, the former providing a wider surface for mortar. The thickness of the face shell and web shall be not less than the values given in Table below:

**Table – 2**
**MINIMUM FACE SHELL AND WEB THICKNESS**

| **Nominal Block Width** | **Minimum Face Shell Thickness** | **Minimum Thickness of Web** | **Total Web Thickness per course in any 200mm length of walling min.** |
|---|---|---|---|
| **(1)** | **(2)** | **(3)** | **(4)** |
| **100 or Less** | **25** | **25** | **25** |
| **Over 100 to 150** | **25** | **25** | **30** |
| **Over 150 to 200** | **30** | **25** | **30** |
| **Over 200** | **35** | **30** | **38** |

e. Subject to the tolerances specified in Clause 8.2.4 (i) and the provisions of (f) The face of masonry units shall be flat and rectangular, opposite face shall be parallel and all arises shall be square. The bedding surfaces shall be at right angles to the faces of the blocks.

g) Blocks with special faces shall be manufactured and supplied as directed by the Engineer.

**iv. Curing and Drying**

The blocks shall be cured in an immersion tank or in a curing yard and shall be kept continuously moist for at least 14 days. When the blocks are cured in an immersion tank, the water of tank shall be changed at least every four days.

After curing, the blocks shall be dried in shade before being used on the work. They shall be stacked with voids horizontal to facilitate through passage of air. The blocks shall be allowed to complete their initial shrinkage before they are laid in wall.

**v. Construction of Masonry**

For single storied buildings, the hollows of blocks in foundation and basement masonry shall be filled up with sand and only the top foundation course shall be of solid blocks. But for two or more storied buildings, solid concrete blocks shall be used in foundation courses, plinth and basement walls, unless otherwise indicated. If hollow blocks are used, their hollows shall be filled up with cement concrete 1:3:6 using 12.5mm nominal size aggregates.

**vi. Wetting of blocks**

Blocks need not be wetted before or during laying in the walls. Incase the climate condition so require, the top and the sides of the blocks may only be slightly

moistened so as to prevent absorption of water from the mortar and ensure the development of the required bond with the mortar.

**vii. Laying**

Blocks shall be laid in mortar, as indicated and thoroughly bedded in mortar, spread over the entire top surface of the previous course of blocks to a uniform layer of not less than 10mm and not more than 12mm in thickness. All courses shall be laid truly horizontal and all vertical joints made truly vertical. Blocks shall break joints with those above and below for not less than quarter of their length. Precast half length closers (and not cut from full size blocks) shall be used. For battered faces, bedding shall be at right angles to the face unless otherwise directed. Care shall be taken during construction to see that edges of blocks are not damaged.

**viii. Provision for door and window frames**

A course of solid concrete block masonry shall be provided under door and window openings (or a 10cm thick precast concrete sill block under windows). The solid course shall extend for at least 20cm beyond the opening on either side. For jambs of very large doors and windows either solid units are used, or the hollows shall be filled in with concrete of mix 1:3:6, using 12.5mm nominal size aggregates.

**ix. Provisions for roof**

The course immediately below the roof slab shall be built with solid blocks. The top of the roof course shall be finished smooth with a layer of cement and coarse sand mortar 1:3, 10mm thick and covered with a thick coat of white wash or crude oil, to ensure free movement of slab.

**x. Intersecting Walls**

When two walls meet or intersect and the courses are to be laid up at the same time, a true masonry bond between at least 50% of the units at the intersection is necessary. When such intersecting walls are laid up separately, pockets with 20mm maximum vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built into these pockets.

**xi. Piers**

The top course of block in the pier shall be built in solid blocks. Hollow concrete block shall not be used for isolated piers, unless their hollows are specified to be filled with cement concrete.

**xii.** Fixtures, fitting, etc. shall be built into the masonry in cement and coarse sand mortar 1:3 while laying the blocks where possible. Holdfasts shall be built into the joints of the masonry during laying.

**xiii.** Holes, chases, sleeves, openings, etc. of the required size and shape shall be formed in the masonry with special blocks while laying, for fixing pipes, service lines, passage of water, etc. After service lines, pipes, etc. are fixed, voids left in any shall be filled up with cement concrete 1:3:6 (1 cement, 3 coarse sand: 6 stone aggregate 20mm nominal size) and neatly finished.

**xiv. Finishes**

Rendering shall not be done to the walls when walls are wet. Joints for plastering or pointing as specified shall be raked to a depth of 12mm. Joints on internal faces, unless otherwise indicated, shall be raked for plastering. If the internal faces of masonry are not to be plastered the joints shall be finished flush as the work proceeds or pointed flush where so indicated.

# SPECIFICATION FOR WOOD WORKS

## 9.0 Wood work

### 9.1 General

Reference shall be made to the following Indian standards:

| | |
|---|---|
| **IS: 2202 Part – I** | **Specifications for wooden flush door shutters (solid core type) plywood face panels** |
| **IS: 2202 Part – II** | **Specification for wooden flush door shutters (Solid core type) practice board and hard board face panels** |
| **IS: 1003 Part – I** | **Specification for Timber paneled and glazed shutters – Door shutters** |
| **IS: 3087** | **Specification for wooden particles boards(medium density)for general purposes.** |
| **IS: 3097** | **Specification for veneered particles board** |
| **IS: 848** | **Specification for synthetic Resin Adhesives for plywood (Phenolic and Cemins plastic)** |
| **IS: 205** | **Specification for non ferrous metal butt hinges** |
| **IS: 2338** | **Code of Practice for finishing of wood and wood based materials (Part I & Part II)** |
| **IS: 1341** | **Specification for steel butt hinges** |
| **IS: 4021** | **Specification for timber door, window and ventilator frames** |
| **IS: 303** | **Specification for plywood for general purposes** |
| **IS: 281** | **Specification for Aldrops** |
| **IS: 204** | **Specification for Tower bolt** |
| **IS: 208** | **Specification for door handles** |
| **IS: 1823** | **Specification for door stoppers** |
| **IS: 2209** | **Specification for Mortice locks** |
| **IS: 3847** | **Specification for Mortice night latches** |
| **IS: 5899** | **Specification for bathroom latches** |
| **IS: 7196** | **Specification for hold fasts** |
| **IS: 3564** | **Specification for door closers** |

### 9.2 Material

#### 9.2.1 Timber

**9.2.1.1 Teakwood**

Teakwood shall be second class Indian Teakwood conforming to IS: 4021 of good quality, well seasoned and free from defects such as cracks, dead knots, sapwood, etc. No individual hard and sound knot shall be more than 15 Sqcm. in size and the aggregate area of such knots shall not exceed 2% of the areas of the piece. The timber shall be fairly close grained having not less than 2 growth rings per cm. width in cross – section.

**9.2.1.2 Hard Wood**

Hard wood shall be first class wood conforming to IS: 4021 of good quality, well seasoned and free from defects such as dead knots, cracks, sapwood, etc. No individual hard and

sound knot shall exceed 6 Sqcm. in size with no dimension more than 50mm and the aggregate area of such knots shall not be more than 1% of the area of the piece.

There shall not be less than 5 growth rings per cm. width in cross – section.

**A) Sal wood**

Sal is heavier, harder, stronger, more shock resistance than teak. Its hard wood is a naturally durable wood, and usually remains immune to attack by white ants and fungi for a long period, while its sapwood is very perishable and should not be used. Well dried sal is not a really easy wood to saw and work. It is a rough constructional wood than a carpentry timber. No individual hard and sound knot shall exceed 25mm in diameter and the aggregate area of all the knots shall not exceed 1% of the area of the piece

It can be used for a variety of purposes, such as for beams, rafters, flooring, piles, bridging, tool handles, picker arms, tent pegs, etc.

**9.2.1.3 Moisture Content in Timber**

The maximum permissible percentage of moisture content for well seasoned timber shall be as per IS: 287.

**9.2.1.4 Workmanship of Wood Work**

Workmanship for wood and joinery shall be as per IS: 1200 and IS: 4021.

**9.2.1.5 Painting / Polishing of Wood Work**

Painting / polishing of wood work shall be in accordance with material specification no. **2.17**.

**9.3 Wooden Door / Window Frame**

Wooden door / window frame shall be made of specified wood as per item description and shall be in accordance with detailed drawings. The wooden members of the frame shall be planed smooth and accurate to the full dimension. Rebates, rounding, moulding, etc. shall be done before the members are jointed into frames. Joints in the frame work shall be perfect with square edges and shall be pinned with hard wood / bamboo pins of 10 to 15mm dia.

Wood work shall be painted / polished or otherwise treated as specified. All exposed portions shall be coated with wood primer and concealed surface by bituminous paints as per material specification no. **2.17**.

Before any surface treatment is applied, the wood work shall be got approved by the Engineer. The frames shall be fixed only after acceptance by the Engineer.

**9.4 Shutters**

**9.4.1 Teakwood Board / Shutters**

**9.4.1.1** Specification for Teak wood shall be same as specified material specification no **2.14**.

**9.4.1.2 Hinges**

Hinges shall be as provided in Bill of Quantities.

**9.4.1.3 Workmanship**

All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane. In case of double shutters, the meeting of the shutters shall be rebated by one third the thickness of shutter. The rebating shall be splayed. The shutter then shall be veneered whenever required by gluing approved shade and textured

commercial type 0.5mm thick veneering conforming to IS: 303. The veneering shall be done by gluing the veneer with BWP type, phenol formaldehyde synthetic resin conforming to IS: 848 by hot press process on the shutter. Workmanship and finished of the veneering shall conform to IS: 303. The exposed surfaces of the lapping of the edges shall be as directed by Engineer – in – Charge.

The shutter shall be fixed to the door frame, by means of minimum three hinges per lead, maximum spacing of hinges being 600mm or as per drawing with suitable sized screws.

The shutter when fitted to the frame shall satisfy all operational aspects of the door like smooth movement, proper closing against the door frame, etc.

### 9.4.2 Flush Shutters

**9.4.2.1** Flush door shutters shall have to be specified door make / or equivalent to conform manufacture's specifications. Thickness and type of shutters shall be as specified. The shutters shall have a solid core and may be of decorative or non – decorative (paintable) as per IS: 2202 – 1991 (Part II). Thickness and type of shutter shall be specified. Lapping shall be done with battens of first class hard wood or as specified and of depth not less than 25mm and provided internally on all edges of shutters. Hinges shall be as specified in Bill of quantities.

Workmanship shall be as in **9.4.1.3**.

In the alternative, flush door of country wood frame treated with chemical impregnation and mechanical kiln dried to 10 – 12% moisture content and core filled with web form of hexagonal cells made out of composite material of Lingo cellulose fibres (for internal use), filled with water resistant low density fibre board (for external use) and provided with rails and styles of not less than 50mm in suitable locations for fixing locks, etc.

### 9.4.3 Panelled Shutters

**9.4.3.1 Materials shall be as specified in 9.2.1.1 to 9.2.1.3**

Panelled or glazed shutters for doors, windows, ventilators and cupboards shall be constructed in the form of timber frame work of stiles and rails with panel inserts of timber, plywood, block board, veneered particle board, fibre board wire gauge or sheet glass, the shutters, single or multi – panelled as shown in the drawings or as directed by the Engineer – in – Charge, thickness of shutters shall be as specified. All members of the shutter shall be straight without any wrap or bow and shall have smooth well planed face at right angles to each other. Any wrap or bow shall not exceed 1.5mm. the right angle for the shutter shall be checked by measuring the diagonals and the difference between the two diagonals should not be more than ± 3mm.

**9.4.3.2 Frame Work**

Timber for stiles and rails shall be of the same species and shall be sawn in the directions of grains sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions. The stiles and rails shall be joined to each other by plain or haunched mortice and tenon joints and the rails shall be inserted 25mm short of the width of stiles. The bottom rails shall have double tenon joints and for other rails single tenon joints shall be provided. The lock rails of door shutter shall have its centre line at a height of 800mm form the bottom of the shutters unless otherwise specified. The thickness of each tenon shall be approximately one third the finished thickness of the members and the width of each tenon shall not exceed three times its thickness.

**9.4.3.3 Panelling**

The panel inserts shall be either framed into the grooved or housed in the rebate of stiles and rails. Timber, plywood, hardboard and particle board panels shall be fixed only with

grooves. The depth of the groove shall be 12mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into the grooves of stiles and rails to the full depth of the groove leaving on space of 1.5 mm. Width and depth of the rebate shall be equal to half of the thickness of stiles and rails. Glass panels, asbestos panels wire gauge panels and penal inserts of cupboards shutters shall be housed in the rebates of stiles and rails. For all panelled door IS: 1003 – 1991 to be followed.

**9.4.3.4 Timber Panels**

Timber panels shall be preferably made of timber of large width, the minimum width and thickness of the panel shall be 150mm and 15mm respectively, unless otherwise specified. When made from more than one piece, the pieces shall be jointed with a continuous tongued and grooves joint glued together and reinforced with headless nails at regular intervals not exceeding 100mm. Depth and thickness of such joint shall be equal to one third of thickness of panel. The panels shall be designed such that no single panel exceeds 0.5 Sqm. in area. The grains of timber panels shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified.

**9.4.4 Glass Panels**

Glass Paneling (Glazing), if any, shall be done with float glass of ordinary quality as specified. Glazing in the shutters of doors, windows and ventilators at bath, WC and lavatories shall be provided with frosted glass, the weight of which shall not be less than 10 kg / Sqm. Frosted glass shall be fixed with frosted face on the inside. Glass panels shall be fixed by providing a thin layer of putty conforming to IS: 419 applied between glass pane and all along the length of the rebate and also between glass panes and wooden beading. Glass shall be free from flaws, scratches, cracks, bubbles.

**9.4.5 Particle Board Flush Shutter**

Particle board flush shutter shall in general conform to IS: 2202.

**9.4.5.1 Materials**

**9.4.5.1.1 Particle Board**

Particle board shall conform to IS: 3097 and shall be of three layers, flat pressed teakwood base and of exterior grade (Grade – I), type – 1, BWP (Boil Water Proof) type, bonded with Phenol Formaldehyde Synthetic Resin conforming to IS: 848.

**9.4.5.1.2 Veneers**

Veneers shall conform to Class – 1 of IS: 303 and (BS: 476 Part – 7).

**9.4.5.1.3 Teakwood**

Specification of Teakwood shall be same as specified in Clause **9.2.1.1**.

**9.4.5.1.4 Hinges**

Hinges shall be of extruded aluminium alloy and butt type conforming to IS: 205. Size of hinges shall be in accordance with shutter width and as per IS: 205.

**9.4.5.2 Workmanship**

The particle board of required size and thickness shall be lapped on all the edges with T – type, teakwood lapping. The overall board lapping composition shall be of uniform and specified thickness and shall be properly sized in view of the operation of shutter. All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane. In case of double leaf shutters, the meeting of the stiles shall be riveted by one third the thickness of shutter. The riveting shall be splayed. The shutter then

shall be veneered on both faces by gluing approved shade and textured commercial type 0.5mm thick veneering conforming to Class I of IS: 303. The veneering shall be done by gluing the veneer with BWP type, Phenol Formaldehyde Synthetic Resin conforming to IS: 848 by hot press process on the shutter. Workmanship and finish of the veneering shall conform to IS: 303. The exposed surfaces of the lapping of the edges shall be french polished in accordance with material specification no **2.17**.

The shutter shall be fixed to the door frame by means of hinges @ minimum 3 hinges per lead, maximum spacing of hinges being 600 mm or as per drawing with suitable sized screws.

The shutter when fitted to the frame shall satisfy all operational aspects of the door like smooth movement, proper closing against the door frame, etc.

**9.4.6 Medium Density Fibre Board Panel Shutter**

MDF board panel shutter shall in general conform to IS: 1003.

**9.4.6.1 Materials**

**9.4.6.1.1 MDF Board**

Medium density fibre board shall conform to IS: 12406, exterior grade (EGSB). It shall be dense, homogeneous and manufactured from agro based lingo cellulose fibres bonded with BWP type Phenol Formaldehyde Synthetic Resin conforming to IS: 848. It shall be categorised as Class I for 'Surfaces of very low flame spread' as per IS: 1642.

**9.4.6.1.2 Teakwood**

Specifications of teakwood shall be same as specified in Clause No. **9.2.1.1**.

**9.4.6.1.3 Synthetic Enamel Paint and Primer**

Specification of synthetic enamel paint and primer shall be same as specified in material specification no. **2.17**.

**9.4.6.1.4 Hinges**

Specification of hinges shall be same as specified in **Clause 9.4.1.2**.

**9.4.6.2 Workmanship**

Teakwood stiles top rail and bottom rail of specified thickness and size shall be provided with suitable rebate. The MDF board shall be fitted by means of teakwood moulded beading of appropriate cross section. The beading shall be fixed by means of approved make neoprene based adhesive and nailing. All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane. In case of double leaf shutters, the meeting of the stiles shall be riveted by one third the thickness of shutter. The riveting shall be splayed. The surface of the teakwood stiles and rails shall be coated with 2 layers of approved quality polyurethane transparent coat with stainer to achieve the desired shade. The shutter shall be fixed to the door frame by means of hinges @ minimum 3 hinges per leaf, maximum spacing of hinges being 600mm or as per drawing with suitable sized screws. The shutter when fitted to the frame shall satisfy all operational aspects of door like smooth movement, proper closing against the door frame, etc. The joints between stiles / rails and the panel shall be properly finished. Extra neoprene adhesive shall be removed and no gap between panel and stiles / rails shall be permitted. Any stain of paint on the panel surface shall be properly removed.

**9.4.7 Glazed wooden door shutter**

**9.4.7.1 Materials**

**9.4.7.1.1 Wood**

Teakwood for various members like stiles, rails, etc. shall be as specified in **Clause No. 9.2.1.1**.

**9.4.7.1.2 Glazing**

Glass sheets for glazing shall be (i) 4mm thick plain glass (wt. 7.2 kg / Sqm.) conforming to IS: 2835 or (ii) 5.5mm thick wired glass conforming to IS: 5437 or (iii) 6.3mm thick laminated glass conforming to IS: 2553 as the case may be as per items descriptions or (iv) 5.5mm thick toughened glass.

Glass sheets shall be free from flaws, scratches, cracks, bubbles, etc.

**9.4.7.1.3 Hinges**

Hinges shall be as specified in **Clause 9.4.5.1.4**.

**9.4.7.2 Workmanship**

Teakwood stiles and rails of size as specified in items descriptions shall be cut accurately and planed smoothly to required dimensions as per drawing. The stiles and rails shall be provided with rivets for fixing the glazing and shall be jointed together to form the profile of the shutter as per drawing. The joinery work shall be approved by the Engineer. Only after such approval, the joints shall be coated with white lead, pressed and secured by hardwood pins of about 6mm dia. All the four edges of the shutter shall be square. In case of double leaf doors, rivets shall be provided at the meeting of stiles. Rivets shall be splayed type and one third the thickness of the stiles. The glass sheets for glazing shall be fixed by teak wood beading having mitre joints as per drawings and shall be fixed by means of approved neoprene based adhesive and nailing, the spacing between the nails being no more than 300mm. All wooden surfaces shall be coated with 2 coats of approved make polyurethane with stainer mixed to achieve desired shade. The shutter shall be fixed to the door frame, by means of hinge at minimum 3 hinges per leaf, maximum spacing of hinges being 600mm or as per drawing with suitable sized screws. The shutter when fitted to the frame shall satisfy all operational aspects of the door like smooth movement, proper closing against the door frame, etc.

**9.4.8 Flymesh Shutter for door and window**

Specifications for Flymesh Shutter shall be similar to the specifications for wooden glazed door, except following features.

- In place of glass, net of galvanised MS wire mesh of IS gauge designation 856 wires and dia 0.56mm shall be fixed to the shutter frame with teakwood beading as per drawing.
- Flymesh shutter shall be for both doors as well as windows.
- All wooden surface shall be painted with synthetic enamel paint of approved shade in two coats over a priming coat in place of french polishing.

**9.5 Steel Doors, Windows, Ventilators, Rolling Shutters & M. S. Grills, etc.**

Steel used in manufacturing of rolled steel sections shall not have more than 0.060% of sulphur and 0.065% of phosphorous. The carbon content shall not exceed 0.30% and shall be of weldable quality. In all other respects, the rolled steel sections shall conform to IS: 226 – 1955 and IS: 1977 – 1962. All steel doors, windows and ventilator must be as per IS: 1038 – 1983 (Third Revision). Frames shall be square and flat. Both the fixed and openable frames shall be constructed of sections which have been cut to length, mitred and electrically welded at corners. Sub dividing bar units shall be tenoned and riveted into the frames. All frames shall have the corners welded to true right angles and welds shall be neatly cleaned off. Couplings, mullions, transom shall be done as directed by Engineer. Outer frames shall be provided with fixing holes centrally in the web of the sections and fixing screws and lugs shall be used for fixing the frame to masonry. Mastic cement shall be used for making the joints watertight.

Hinges shall be strong of projecting type. If directed, friction type hinges shall be used in which case windows shall not be fitted with peg stays. Projecting type hinged shutter shall be fitted with bronze or oxidised brass peg stays, 30cm long with pegs and brackets welded / riveted to the frame.

All windows shall be provided with handles of oxidized brass or bronze, as may be specified.

Top hung ventilators shall be fixed with plain hinges riveted / welded to the fixed frame. Oxidized brass or bronze peg stay of 30 cm long shall be provided in windows.

Centre hung ventilators shall be hung on two pairs of brass of leaded tin bronze cup pivots riveted to the inner and outer frames of the ventilators to permit the ventilator to swing through an angle of approximately 85 degrees. The opening positions of the ventilator shall be so balanced to keep it open at any desired angle under normal weather conditions. A bronze spring catch shall be fitted in the centre of the top bar of the ventilator for operation of the ventilator. This spring catch shall be secured to the frame with brass screws and shall close into a mild steel malleable iron catch plate riveted or welded to outside of the outer ventilator frame bar. A brass cord pulley wheel on mild steel or malleable iron brackets shall be provided along with cord eye.

The windows and ventilators shall be painted. All the steel surfaces shall be thoroughly cleaned free of rust, scale or dirt and mill scale by picking or phosphating and before erection painted with one coat of approved primer and after erection with two finishing coats of synthetic paint of approved shade and quality.

Glazing of specified thickness shall be provided on the outside of frames and unless otherwise specified, metal beadings of approved shape and section shall be used for fixing glasses. Special metal sash putty of approved make shall be used, if directed.

### 9.6 Rolling Shutters

Rolling Shutters shall be of approved manufacture and suitable for fixing in the position ordered i.e. out side, inside on or below lintel or between jambs. Shutters upto 12 Sqm. (130 Sft.) in area shall be manually operated, of 'Push up' type while bigger sizes shall be of reduction gear type mechanically operated by chain or handles unless otherwise provided in the schedule of quantities. These shall consist of 8 gauge or as specified with 75mm (3") M. S. laths of best quality mild steel strip, machine rolled and straightened with an effective bridge depth of 16mm (5/8") and shall have convex corrugations. These shall be interlocked together throughout their entire length with end locks. These shall be mounted on specially designed pipe shaft. Springs shall be of approved make, coiled type. These shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in position. The spring, pile shaft, etc. shall be supported on strong MS or malleable cast iron brackets. Both the side guides and bottom rail shall be jointless and of single pieces of pressed steel. Top cover of shaft, spring, etc. shall be of the same material as that of lath. For rolling shutter with wicket – gate, night latch shall be provided free of cost. The shutter, cover, etc. shall be painted with one coat of anticorrosive paint before fixing and two coats of synthetic enamel paint of approved quality and shade after fixing in position. All metal rolling shutters must be as per IS: 6248 – 1979 (First Revision).

### 9.7 Collapsible Steel Gate

It shall consist of vertical double channels at 10cm c/c. The sizes of channels / T – sections for top and bottom shall be as approved by the Engineer. The gate shall be provided with necessary bolts, nuts, locking arrangements, stoppers and brass handles on both sides. The gate shall be painted with one coat of anticorrosive paint before erection and two coats of synthetic enamel paint of approved quality and shade after erection.

### 9.8 Wrought Iron Grills

Grills shall be manufactured as per drawings and the welded joints shall be smooth. The grills shall be painted with one coat of anticorrosive paint before fixing and two coats of synthetic enamel paint of approved quality and shade after fixing.

**9.9 Aluminium Doors, windows, Ventilators & Partitions, etc.**

These shall be obtained from approved and established manufacturers and shall be of aluminium alloy conforming to IS: 733 and sections shall generally conform to IS: 1948 – 1961. These shall be fabricated as per the detailed drawings.

Frames for windows, ventilators, etc. shall be square and flat. Both fixed and openable frames shall be constructed of sections which have been cut to length, mitred and welded at corners. Sub dividing bars shall be tenoned and riveted into frames. All frames shall have corners welded to a true right angle. For side hung shutter, hinges shall normally be of projecting type made of aluminium alloy and riveted / welded to frames and shall have stainless steel pins. Handles, peg stays, etc. shall be of approved quality aluminium or its alloy conforming to IS specifications.

All types of shutters shall be fabricated, supplied and fixed as specified in IS: 1948 – 1961. The rate shall include supplying and fixing all fittings and fixtures required for proper and safe operation.

The doors shall be fabricated by using standard aluminium alloy extruded section as specified in IS: 1948 – 1961. The rate shall include supplying, fixing and fitting fixtures including approved locking arrangements as directed. All aluminium fabrication work shall be anodised as specified in IS: 6057 – 1970 to give an anodic film of 15 microns unless otherwise specified.

The Tenderer shall take care to stack the fabricated frames, etc. on site under cover. They shall be handled with care, stacked on edge on level bearers and supported evenly. Before erecting, frames coming in contact with concrete, masonry, plaster or dissimilar metals shall be coated with a coat of zinc chromate conforming to IS: 104 – 1950. The Tenderer shall cover all anodized finish work with a thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate to protect the surface from wet cement during installation. This coating shall be removed on completion. Before handing over, the aluminium work shall be washed with mild solution of non alkali soap and water.

**9.10 Glazing**

Glazing shall be of glass of approved, specially selected quality and thickness as specified and unless otherwise directed it shall be provided on the exterior with metal beading.

**9.11 Precast Reinforced Concrete Door and Window Frames**

Manufacture of precast reinforced concrete door and window frames is described here. These will conform to IS: 6523 in all respects unless otherwise specified. Frames shall be manufactured in an approved factory with all necessary arrangements for fixing hinges or hinges fixed at position as specified with hole for receiving tower bolt, sliding bolt, etc. as specified.

**9.11.1 Shape and Dimensions**

Precast reinforced concrete door and window frames shall be 60 X 100mm or 70m X 75mm in cross section for single shutter and 60 X 120mm for double shutter door, cross section shall generally conforms to architectural drawings. Where specified, suitable groove for receiving wall plaster shall be provided. The overall sizes (width and height) shall be as per drawing or as specified.

**9.11.2 Materials**

The materials used for manufacturing of the frames shall comply with standards given in Table I of IS: 6523.

**9.11.3 Aggregate**

The aggregate used shall be of well graded mixture of clean coarse and fine aggregates. The nominal size of coarse aggregate shall not exceed 10mm.

**9.11.4 Concrete**

Mix of concrete shall be as specified or as directed by the Engineer. But the mix shall not be weaker than M20 controlled mix and shall be suitable for producing a dense concrete without voids after proper vibration. There shall be a minimum of three bars of 6mm. The longitudinal reinforcement for each vertical or horizontal member shall be one piece and shall be firmly held by 3mm dia ties spaced at not more than 300mm c/c. The longitudinal reinforcement shall have a maximum cover of 12mm or twice the diameter of main bar, whichever is higher.

**9.11.5 Casting**

The entire frame may be cast complete in one piece or each of the vertical and horizontal members of the frame may be cast separately to be assembled into the complete frame at site. When the frame is cast in separate parts, one of the reinforcing bars of the vertical members of the frame shall be kept projecting so as to tenon into the corresponding hole in the horizontal member. The holes in the horizontal member for taking the projecting reinforcement from the vertical members shall be slightly larger than the bar diameter to facilitate easy insertion of the projecting bar. After assembly at site, the holes shall be grouted with cement slurry of 1 cement: 2 coarse sand.

**9.11.6 Mould**

The mould for casting shall preferably be of steel to ensure better surface finish of the cast frame. Provision shall be made in the mould to accommodate fixing devices for hinges and the hold fasts. Where specified, suitable rivets may also be provided to act as plaster groove.

**9.11.7 Protection and Curing**

After casting in moulds, during setting and in first stage of hardening the concrete, shall be protected from shocks, running or surface water and the harmful effect of frost, sunshine drying winds and cold. The concrete shall be cured for at least 7 days unless special curing methods are adopted which shall conform to IS: 6523.

The frames shall be matured before testing or dispatch for the following periods.

| **Type of cement used** | **Period** |
|---|---|
| Ordinary portland cement, portland blast furnace slag cement, Portland pozzolana cement | 28 days |
| Rapid hardening cement (to be used with approval of Engineer) | 14 days |

The frames after maturing shall have sufficient strength to prevent damage when handled.

**9.11.8 Arrangements for Fixing of Hinges to Frames**

Suitable arrangements for fixing hinges shall be provided in the frame by one of the following methods as directed:

**Hardwood Fixture**: Hardwood blocks of well seasoned teak or other suitable timber 150mm long, 45 to 50mm X 30mm to 40mm in cross section, one block for each of the hinge, shall be fixed in position with 6mm mild steel bolts, nuts and washers, after the frame has been cast, cured and matured. After tightening the nuts, the bolt heads and the nuts shall be suitably covered with hard wood fillets, finished flush with concrete surfaces of the frame.

**Hinge directly attached to frame**: L type flap hinge may be attached directly to the frame with the help of 6mm dia mild steel bolts and nuts.

**Hinge welded to frame**: The hinge may be welded to 3mm thick mild steel flat embedded in a frame.

**9.11.9 Arrangements for Door and Window Fixtures**

Suitable arrangements shall be provided in the frame for receiving tower bolts, sliding bolts and other door and window fixtures as indicated.

**9.11.10 Fasteners**

Arrangements for fixing the frames with holdfasts or metallic fasteners shall be provided in vertical members of frames as specified. In case of door frame, there will be 3 nos. holdfasts and in case of window, there will be 2 nos. holdfasts on each vertical members in contact with the opening where the frame is to be fixed. Holes to accommodate 10mm dia bolts to be fixed to holdfasts and the nuts shall be left at appropriate locations.

**9.11.11 Erection**

When a three piece frame is used, the vertical members shall be held in position with top member placed over them, the whole frame plumbed and firmly supported till the concrete around the holdfasts in the masonry has properly set and hardened. Cement and coarse sand mortar slurry 1:2 shall be used in grouting the joints between the vertical and horizontal members of door frame. In case, where four members are used, the bottom member shall be first placed in position and other erected on this base.

**9.12 Hardware Fittings**

All hardware fittings and fixtures shall be made with structural properties to sustain safety and withstand strains and stresses to which they are normally subjected to such as opening and closing, wind pressure, etc. The fittings shall generally conform to relevant specifications. They shall be made true, clean, straight, with sharply defined profiles and unless otherwise shown or specified, with true smooth surfaces and edges, free from defects, screw holes shall be counter sunk to suit the head of wood screws. The metal shall be treated with finish as specified in the Bill of Quantities.

**9.13 Bath and Toilet Doors**

PVC doors for bathrooms and toilet are made from sizes as per drawing for main outer frame and shutter shall be made from multi chamber hollow plastic section 20mm thick and shutter outer frame shall be of extruded plastic section DWUF 302 (24mm X 59mm) with hardware fittings as per the colour approved. Alternatively Formica / Decolam laminated 30cm wide from the bottom over one side plastic coated flush door also to be considered for external doors.

For internal doors, do as above but the laminated sheet will be of both sides.

**9.14 Fixing of Glass Louvers in Wood / Steel Frame Ventilators**

In wooden frames angular grooves shall be made as shown in the drawing and glass louvers shall be fixed at the same angle. The glass shall be rigidly fixed with by fitting

the gaps in the grooves by putty, etc. and it shall be nailed all around wooden heading. In addition, 2 / 3 nos. of 12mm M.S. bars shall run through frame to frame horizontally.

**For Steel Frame**

Do as above and the glass louvres will be fixed in the U shaped MS channels riveted to the steel main frame and frame painted with an anticorrosive primer.

**9.15 Providing and Fixing Meter Box Cupboard on Wall**

The frame shall be of specified size and class of wood. It shall be fixed with 2 nos. of holdfasts and the same may be grouted with CC 1:2:4 blocks of size 230mm X 230mm X 300mm. The shutter shall be of 19mm thick nova teak. A slit shall be provided in the shutter as directed by the Engineer. 3mm thick glass shall be fixed in the slit. Architrave shall be provided as directed by the Engineer. Fixtures as specified shall be provided. The shutter, frame and the architrave shall be painted with 3 coats of ISI approved enamel paint.

**9.16 Balustrade and Hand Rails in staircase**

The M.S. railing to detail in staircase and landing shall be fixed along outer edges of the flights and landings with M.S. square bars and flats of specified size as per drawing and neatly welded. The top hard rail over the top flat of the balustrade may be of wood of approved quality or G.I. pipes or hollow box section as specified in the drawing which will be screwed or fitted rigidly as per the direction of Engineer.

**UPVC**

**Sliding Windows without Fly screen**

Providing and fixing of UPVC Sliding Window without fly screen duly manufactured using UPVC reinforced profiles of 60mmx49mm for outer frames, 62mmx41mm for sliding shutter. The minimum wall thickness for the external surfaces shall be 2.2 + 0.3 mm. The system must have 2 sealed chambers for frame and 1 sealed chamber for sliding shutter, capable of mounting single / double glazing system, structurally reinforced with hot dip galvanized steel with 120 GSM of minimum thickness of 1.5mm prefabricated and welded through fusion welding, the window shall be fitted with 5mm thick tinted / float glass of reputed make duly fitted with EPDM weathering seal resistant accessories like clipping locking system made of aluminium 1 No. per set of sashes and the system is to be installed at site using anchor fasteners, silicon sealant, easy glazing / deglazing at site etc. including all lead, lift, loading, unloading & HOM charges, including cost of fixtures and conveyance of all material, accessories, labour charges for transportation, erection at site complete for finished item of work as per the directions of Engineer in charge of work. (UPVC requirements as per Annexure-A)

Providing and fixing of UPVC Sliding Window without fly screen duly manufactured using UPVC reinforced profiles of 60mmx49mm for outer frames, 62mmx41mm for sliding shutter. The minimum wall thickness for the external surfaces shall be 2.2 + 0.3 mm. The system must have 2 sealed chambers for frame and 1 sealed chamber for sliding shutter, capable of mounting single / double glazing system, structurally reinforced with hot dip galvanized steel with 120 GSM of minimum thickness of 1.5mm prefabricated and welded through fusion welding, the window shall be fitted with 5mm thick tinted / float glass of reputed make duly fitted with EPDM weathering seal resistant accessories like clipping locking system made of aluminium 1 No. per set of sashes and the system is to be installed at site using anchor fasteners, silicon sealant, easy glazing / deglazing at site etc. including all lead, lift, loading, unloading & HOM charges, including cost of fixtures and conveyance of all material, accessories, labour charges for transportation, erection at site complete for finished item of work as per the directions of Engineer in charge of work.

Providing & fixing sliding type mosquito proof shutter for uPVC windows including necessary fixing of additional track etc and as per the standard indicated in Annexure-A. The fly screen shall be fitted with Nylon / Aluminium mosquito net of reputed make Saint Gobian / Phifer.

ANNEXURE-A
UPVC profile requirements
Providing and fixing UPVC sliding windows and ventilators as per approved drawings. Profiles UV stabilized to withstand radiation of 180 kCalcm2/annum. Profiles weather fast whereby a colour deviation of > level of the grey scale to ISO-A is admissible. Weathering and light resistance test carried out according t/RAL GZ and procedure as per DIN EN. The profiles tested for release of any harmful vapor or any toxic content tested as per DIN EN ISO 10993-5 or equivalent UPVC window comply with the requirements of final version of ECBC (Energy Conservation Building Code) of Bureau of Energy Efficiency of India, details for the Air leakage and U value of the window to achieve increasing levels of energy performance and to reduce environmental and economic impacts associated with excessive energy use. (EA Credit 1) ad to reduce environmental impacts resulting from transportation. UPVC system articles extrude within 800 kilometres of the window manufacturing facility and fabrication within a distance of 450 kilometres of the project site (MR credit 5). System supplier able to demonstrate previous experience in Govt of India “net zero” project. Sealants used on the interior of the building (defined as inside of the weather proofing system and applied on-site) shall comply with the requirements of the LEED India reference guide. The VOC (Volatile Organic Compounds) contents of adhesives and sealants used must be less than VOC content limits mentioned. Glazing bead assembly tested minimum of 3000 pa positive and negative. Air infiltration for windows not exceed 1 litres / second / m2 (or 3.6 m3/h/m2). The water penetration for windows minimum 300 Pa.

.

# SPECIFICATION

# FOR

# FLOORING

**10.0 Flooring**

**10.1 Flooring, Skirting, Dado & Stone Veneering**

All Flooring, skirting, dado, stone veneering, etc. shall be executed strictly as per relevant Specification and in workmanship like manner.

**10.2 Granolithic Flooring**

Selection of materials, method of mixing, placing and compaction shall generally conform to the specifications under plain and reinforced cement concrete described earlier. A stiff mix consistent with workability shall be used.

**10.2.1 Preparation of Surface**

Before the operation for laying is started the surface of base concrete shall be thoroughly cleaned of all dirt, loose particles, caked mortar droppings and laitance, if any, by scrubbing with coir or steel wire brush, where the concrete has hardened so much that roughening of surface by wire brush is not possible, the surface shall be roughened by chipping or hacking at close intervals. The surface shall then be cleaned with water and kept wet for 12 hours, surplus water being removed by mopping before the topping is laid.

**10.2.2 Laying**

The screed strips shall be fixed over the base concrete dividing it into suitable panels. Before placing the concrete for topping, neat cement slurry shall be thoroughly brushed into the prepared surface of the base concrete just ahead of the finish. Concrete of the specified proportion and thickness shall be laid in alternate panels to the required level and slope and thoroughly tamped. The cement concrete flooring must be as per the standard practice of Karnataka PWD Schedule under flooring items and as directed by Engineer.

**10.2.3 Finishing the Surface**

After the concrete has been fully compacted, it shall be finished by trowelling or floating with neat cement rendering. Finishing operations shall start shortly after the compaction

of concrete and the surface shall be trowelled three times at intervals so to produce a uniform and hard surface. The satisfactory resistance to wear of the flooring depends largely upon the care with which trowelling is carried out. The time interval allowed between successive trowellings is very important.

Immediately after placing cement rendering, just sufficient trowelling shall be done to give a level surface. Excessive trowelling in the earlier stages shall be avoided as this tends to bring a layer rich in cement to the surface, sometime after the first trowelling, the duration depends upon the temperature, atmospheric conditions and the rate of set of cement used, the surface shall be retrowelled to close any pores in the surface and to bring to surface the excess water in concrete or laitance which shall be removed. No dry cement shall be used directly on the surface to absorb moisture or to stiffen the mix. The final trowelling shall be done before the concrete has become too hard but at such a time that considerable pressure is required to make any impression on the surface.

When instead of 1:2:3 or 1:2.5:3.5 mix, 1:2:4 mix is specified, the topping shall be rendered with 1:1 cement mortar instead of cement only.

If directed by the Engineer, approved mineral pigment shall be added to the rendering to obtain desired colour and shade to the flooring at no extra cost, unless otherwise provided for in the schedule of quantities.

The floor shall be machine polished as per Engineer's instructions, if so specified in the schedule of quantities.

Wherever patent stone flooring is used as a finishing on roof, the joints shall be filled with an approved bitumastic filler in workmanship like manner.

### 10.2.4 Ironite Topping

Instead of finishing the top with rendering coat of 1:1 cement mortar, the flooring shall in this case be finished with 12mm ironite topping. Unless otherwise specified, one part of ironite and four parts of ordinary cement by weight shall be mixed and dry thoroughly. This dry mixture shall be mixed with stone grit 6mm (1/4") down size or otherwise directed in the ratio of 1:2 by volume and shall be turned over. Enough water shall be added to this dry mix and the thoroughly mixed composition shall be laid and compacted to uniform thickness of 12mm. After initial set has started, the surface shall be finished as directed.

### 10.3 Plain and Coloured Cement Tile, Marble Mosaic and Terrazzo Tile Flooring

The tiles shall conform to IS: 1237 – 1980, having the colour approved by the Engineer and the rate shall include provision of border tiles and tiles of different colours in pattern. If directed, the mosaic topping of lighter shade tiles shall be made of white cement with an approved shade pigment and neutral shade tiles shall be of gray cement with an approved shade pigment. The type of tiles shall be as specified in respective items.

The sub grade shall be thoroughly wetted after cleaning off all dirt, laitance and loose material. A bed of lime mortar consisting of one part of lime and two parts of sand shall be laid and properly levelled to an average thickness of 20mm and the surface shall be kept slightly rough to form a satisfactory key for tiles. Neat cement paste of honey like consistency shall be spread over mortar bed, over such area at a time as would accommodate about 20 tiles. Tiles, which had been soaked in water for 15 minutes and allowed to dry for the same duration shall then be fixed with a thin coat of cement paste at the back of each tile, which shall be then gently tapped with a wooden mallet till it is properly bedded and is level with adjoining tiles. Joints shall be fine and as imperceptible as possible.

After the tiles have been laid in a room or a day's fixing work is completed, surplus cement grout that may have come out of the joints will be wiped off gently and the joints cleaned. A thin slurry of coloured cement matching the colour of tiles shall be spread over and rubbed so to seal even the thinnest joints between the tiles and make the floor surface impervious. The flooring shall be cured for 7 days. The tiles shall then be polished and finished according to IS: 1443 – 1972.

**10.4 Dado, Skirting and Risers**

Tiles shall conform to IS: 1237 – 1980 and shall be of approved design. The tiles shall be fixed with neat cement grout on a backing coat consisting of 1:4 cement & sand and plaster of 12mm thick. The top and bottom junctions of tiles shall be rounded off neatly as directed. The joints shall be filled with matching coloured cement slurry of matching shade. The surfaces shall be kept wet for 7 days and then polished with carborundum stone of different grades to obtain smooth surface and fine polish.

**10.5 Shahabad / Tandur / Cuddapah Stone Flooring**

The floor shall be either with rough or machine cut and machine polished stones as specified in respective items of specified thickness and of approved quality and size, free from cracks and flakes and uniform in colour, with straight edges. The sides of machine cut and machine polished stones shall have perfect right angles and smooth surface. The stone slabs shall be laid and finished as described under plain cement or coloured tiles on bedding of 1:2 lime mortar of 20mm thickness. This finished stone surface thus laid shall then be polished to the required degree as approved by the Engineer.

**10.6 In Dado, Skirting, Risers, etc.**

Stone slabs shall be laid on a backing plaster of cement mortar 1:4, 12mm thick and finished as described under plain and coloured cement tile dado.

**10.7 Marble Mosaic / Terrazzo in situ work in Flooring, Dado, Skirting, etc.**

The terrazzo / mosaic (finish) topping shall consist of a layer of marble chips of selected sizes, colour and design approved by Engineer, mixed with cement with the desired shade of pigment and shall be laid on an under layer of thickness as specified in the respective items.

For lighter shade, mosaic / terrazzo white cement shall be used and for neutral shade, grey cement shall be used. The proportion of terrazzo mix shall be three parts of cement and one part of marble powder by weight. For every part of cement marble powder mix, the proportion of marble aggregate by volume shall be 1.5 parts unless otherwise specified.

The topping shall be mixed and laid in panels as described in IS: 2114 – 1962 and as per decorative designs prepared by Engineer. The dividing strips of panels shall be of Aluminium or as specified in the schedule of quantities. It shall be polished as specified in IS: 2114 – 1962.

**10.8 Broken Mosaic Flooring**

Broken mosaic finish shall be laid on an under layer of thickness as specified in the item. Pieces of mosaic tiles shall be obtained from broken marble mosaic tiles of approved shade conforming to IS: 1237 – 1980. The sizes of pieces shall be suitable to obtain the desired pattern of flooring as shown on the drawings or as approved by Engineer.

Broken pieces shall be thoroughly wetted before fixing them. Ordinary or coloured grout shall be spread on the bedding. Mosaic tile pieces shall be fixed piece by piece to the desired pattern. The flooring shall be laid to correct level and slope and compacted by straight screed tamper. The grout shall cream upto the surface. The junctions of the flooring and the wall shall be rounded and the flooring shall be extended along the wall to about 15cm (6"). After the day's work, the surplus cement grout that may have come out of the joints shall be cleaned off. The flooring shall be cured for seven days and then polished with a machine as stipulated in IS: 1443 – 1972.

**10.9 Broken China Mosaic**

Marble china mosaic flooring shall be exactly as per broken mosaic tile flooring except that the broken pieces shall be of china of approved colour and manufacture and the floor shall not be polished.

**10.10 Marble Flooring**

Marble slabs shall be of the best Indian marble of white or other approved colour as specified in the item. They shall be hard, dense uniform and homogeneous in texture. They shall have even crystalline grains free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges machine out true to square. The rear surface shall be rough enough to provide a key for the mortar.

No slab shall be thinner than the specified thickness at its thinnest part, the sizes of the slabs being as specified in the respective items.

The slabs shall be laid as described under mosaic tile flooring in every respect.

**10.11 White Glazed Tiles in Flooring and Dado**

White glazed tiles from an approved manufacturer conforming to IS: 777 – 1970 shall be used. They shall be of specified size and thickness. All specials viz., covers, internal and external angles, corners, beads, etc. shall be used wherever directed. Under layer of specified thickness and mortar of stipulated proportion shall be laid as described in marble mosaic flooring. Tiles shall be washed clean and set in cement grout, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern. After the tiles have been laid, surplus cement grout shall be cleaned off.

The joints shall be cleared with a wire brush or trowel to a depth of 5mm (3/16") and all dust and loose mortar removed. Joints shall, then be flush pointed with white cement. The floor shall be kept wet for seven days. After curing, the surface shall be washed with mild hydrochloric acid and clean water. The finished floor shall not sound hollow when tapped with a wooden mallet.

**10.12 Marble in Facia or Dado**

Marble slabs of approved shape, variety, size and thickness as specified in the item shall be used. They shall be of selected quality, dense, uniform and homogeneous in texture and free from cracks or other structural defects. The exposed face shall have no veins or unsightly stains and defects. The slabs shall be of uniform milky white or coloured shade or of patterns of colours approved by the Engineer. Samples shall be got approved by the Engineer before ordering the slabs. The surface shall be fine polished and sides machine cut, true to square.

When a single course of marble slab is to be fixed as in dado, etc. the slabs shall be fixed and described below.

Stainless steel clamps to be provided at all joints. Detail drawings for stainless steel clamps will be issued by Engineer.

Mortar pads of 1:2 cement mortar of uniform width shall be stuck on to the wall at close intervals and the marble slabs shall be pressed onto them firmly. The remaining cavities, if any, shall then be filled with thin grout of cement mortar of the same proportion. The sound emanating from the slabs on gentle tapping will indicate if there are hollows. When the hollow cannot be filled with grout and the finished slab continues to give a hollow sound on tapping, the slab shall be removed and reset.

For facia work, where more than one course is required, the marble slabs shall be fixed in the same way as described above except that at horizontal joints of the slabs, adjacent slabs shall be held together by wrought iron / copper pins passing through holes drilled into the slabs. In addition, wrought iron / copper holdfasts / dowels shall be provided to anchor the slabs to the wall. The holdfasts shall be counter sunk into the joints of the slabs and shall be located about a metre apart subject to a minimum of one for each horizontal joint.

The facing shall be fixed truly in plumb and in perfect line or curves as shown on the plans. The courses and joints shall be as directed by Engineer. The surface shall be protected from sun and rain and cured for ten days and shall be finally polished.

The rate shall include cost for erecting and removing double scaffolding, equipment, etc.

**10.12.A Polished or Tool Finished Granite / Malad / Sand Stone**

The facial stone / slab shall conform to the specifications under "Materials" and it shall be erected as shown on the drawing or as directed by the Engineer.

The stone or stone slab shall be of size as shown on the drawing or as directed by the Engineer. The exposed faces, full beds and joints shall be dressed / finished as directed. The joints shall be cut square to the face and shall be at right angles to each other or as directed. The facing shall be fixed in cement mortar truly in plumb and in perfect plane, straight or curved as shown on the drawing, the bed being fully flushed with mortar. The joints shall be exactly vertical and horizontal. The thickness of joint shall not exceed 1mm to 1.5mm for machine polished / fine tooled / close punched and chisel dressed work. The stones shall break joints for about half the height of the course. Courses shall be as shown on the drawing or as directed. The gap between the facing stone and the wall shall be filled with either 1:2:4 concrete or 1:2 cement mortar. Wrought iron / copper pins and holdfasts shall be used wherever directed; lead caulking shall be used for fixing holdfasts. The surface shall be protected from sun and rain and cured for ten days.

The face shall be finished as specified or as directed after filling the joints with matching shade cement / cement mortar of 1:1 proportion mixed with approved water proofing material.

The rate shall include cost for double scaffolding.

**10.13 Vitrum Tiles**

Tiles of colours and design as shown on the drawing or as directed by the Engineer shall be used. They shall be fixed and finished strictly as per manufacturer's specifications and as directed. The rate shall be inclusive of cost for double scaffolding, equipment, etc.

**10.14 Oxy Chloride Flooring**

Oxy Chloride Flooring shall be laid strictly in accordance with IS: 658 – 1982. Materials for flooring shall be obtained in two parts viz., dry mix and magnesium chloride. The proportions of the dry mix to the gauging solution and the strength of the latter shall be as furnished by the manufacturer of the dry mix.

All mix used in the manufacture of dry mix and magnesium chloride shall comply with the requirements of IS: 657 – 1982.

The sub floor shall be roughened to a suitable degree by chiselling, pickling or by any other suitable process and cleaned thoroughly, freed from dust, dirt, grease, etc. before the oxy chloride composition is laid. The cleaned surface shall be dampened with the solution of magnesium chloride of specific gravity 1.08 to 1.10. The wet mix prepared as per manufacturer's instructions shall be laid, in two layers and in panels defined by screed patterns and the surfaces finished as directed.

When marble mosaic finish is specified, the surface shall be machine polished.

**10.15 Vacuum Dewatered Flooring**

The operations described are specialist operations. The specification / procedure suggestion by such operations shall be generally in conformity with the specifications given here.

**Sub grade**: Prepare surface, remove vegetation / loose soil consolidation for the top layer and lay 230mm hard granite stone soling closely packed and the interstices filled with binding material and thoroughly watering and consolidating by a heavy roller to a consolidated thickness of 230mm and bind the top surface.

**Sub base**: Lay cement concrete 1:4:8 of 150mm thick using 2.5cm max. size granite stone jelly.

**Structural slab:** The side rail forms are set to the required level and spacing suited to the width of panel required. Reinforcement mat and also the dowel bars, which act as load transfer device across the joints, are then placed. Concrete of required grade and consistency is then placed in between the rail forms and then vibrated with poker vibrators. Vibrated concrete is then levelled and surface vibrated with surface vibrator. Filter pads and suction mat are then placed over the concrete surface and connected to a suction pump by means of a hose. As soon as the pump is started, a vacuum is created between the top cover and the fresh concrete surface. Immediately after vacuum, dewatering the surface is power floated with a skim floater. If hard top and wearing course are specified on top of vacuum dewatered surface power, floating is to be carried out after the application of hard top.

**10.16 Providing and Laying Ceramic Tiles in Flooring, Skirting and Dado**

The ceramic tiles in flooring and dado shall be of first class quality as specified in the item specification and shall be approved by the Engineer. The tiles shall be of standard size without warp and with straight edges, true and even in shape and size and of uniform colour. The tiles surface shall be of fine grained texture, dense and homogeneous. The thickness of the tile shall be as per the item specification. The tiles shall be submerged in water till the bubbles cease.

The flooring should be laid on a base as specified in schedule item. They shall be laid truly vertical on walls and truly horizontal on floors or to slopes as directed. The joint shall be very thin, uniform and perfectly straight. The tiles in dado shall be finished in such a way that only the tile thickness projects over the finished plaster or as specified otherwise. Where full tiles are not possible, the same should be cut or sawn to the required size and their edge rubbed to ensure straight and true joints. After the tiles are laid extra cement grout shall be removed. The joints shall be cleaned with wire brush and then the joint shall be floated with white or grey cement as approved by the Engineer. The tiles shall be cleaned after the work is complete.

This shall be measured in Sqm. The rate quoted for flooring and dado work shall be inclusive of angles and corner pieces, cutting tiles for water points, such away that the point is in the junction of four tiles, electrical points, etc.

**10.17 Providing and Laying Polished Green Kota Stone Flooring**

Stones shall be of approved quality, size and uniform thickness, edges shall be chisel dressed and the top surfaces shall be machine polished with joints running true and parallel from side to side. Stones shall be laid on a bed of cement or lime mortar. The pattern of the flooring shall be as per the architect's drawing. Thickness of mortar bedding shall be as specified in the item specification. The stone slabs shall be thoroughly wetted with clean water. Neat cement shall be spread over the mortar bed and the slabs shall be placed one by one, keeping in check the level and line of the flooring. The slabs are then gently tapped with wooden mallet till it is firmly and properly bedded. There shall be no voids left. The joints shall not be more than 2mm thick. The joints shall be struck smooth. If specified, terrazzo filling of specified thickness shall be done in the joints between the kota stone slabs. The floor should be kept covered with damp sand or water for a week. Slabs shall be of sizes as specified. The stone shall be machine polished and then cleaned with oxalic acid. If the Tenderer is asked to mop the floor with kerosene and water by the Engineer, the same shall be done without any extra cost. This shall be carried out daily at least for 10 times for 7 days.

**10.17.1 Providing and Laying Kota Stone in Skirting and Dado**

The stone shall be of required sizes and the thickness shall be as mentioned in the item specification. The stones shall be pre polished and machine cut. The stone's edges shall be dressed fine true, straight and at right angles to each other. The stones shall be fixed over cement mortar bed 1:4 (1 cement: 4 coarse sand). The joints are filled with ordinary cement and its hands are wax polished. The joint between the top of skirting / dado and

plaster shall be finished properly. The joints in the flooring shall be continued in the skirting / dado also. The work shall be cured properly.

**10.18 Providing and Laying Granite in Flooring, Skirting and Dado**

The approved quality of acid and alkali preventive primer shall be applied uniformly in two coats over the slab or the concrete surface. The acid-alkali proof powder shall be mixed with the cement in the proportion 2:1 (2 cement: 1 powder) or as per the manufacturer's specification. The cement-powder mix and the sand shall be mixed in the ratio 1:3 and the mortar shall be prepared. The stones shall be laid on the mortar bed in level and line with even thickness of 6mm to 10mm joints all around.

The joints shall be raked to 12-19mm deep and filled with epoxy based resin. The resin is mixed with quick drier and acid-alkali proof powder. As the resin is an atmospheric hardening agent, it does not require curing. The work place shall be kept dry for the joint filling operation. The stones shall be either hand polished or machine polished cleaned with oxalic acid and then wax polished.

**10.19 Granite Tiles Flooring**

Granite Tiles shall be approved colour and quality. They shall be of 10mm 23thick mirror polished and machine cut. The tiles to be used shall be as laid down in the drg. Or as directed by the Engineer. The angles shall be right angles and all edges shall be straight and true.

**10.20 Granite tile skirting**

Specification of granite tiles for skirting shall be same as for granite floor tiles. Joints shall be raked out to a depth of 15mm in masonry walls. The surface shall be thoroughly cleaned, washed and kept wet before laying 12mm thick cement mortar 1:3 (1 cement; 3 coarse sand). Cement plaster shall be allowed to harden. The plaster shall be roughened with wire brushed. Tiles washed clean shall be set in bedded mortar with a liberal coat of cement slurry at the back of tiles. These shall be tapped and corrected to proper plan and line. Joints shall be as thin as possible. Top of skirting shall be truly horizontal. Joints shall be cleaned of grey cement slurry and then be flush pointed with white cement added with matching pigment. It shall be paid in running metre measuring correctly to nearest centimeter.

**10.21 Granite slab over kitchen counter:**

Granite slab shall be of jet black shade and of approved quality. They shall be of 18mm thick machine cut and mirror polished. They shall be laid over RCC slab. The angles shall be right angles and all edges shall be straight and true. Joints shall be permitted when the length is more than 2m. Number of joints in each direction shall not be more than one number for every 2m length beyond the initial 2m. No joints shall be permitted in the direction of width.

Mortar bed shall be of cement mortar. The mortar will be of ratio 1:4 (1cement and 4 coarse sand). After properly cleaning and wetting the base, the mortar shall be evenly and smoothly spread over the base by the use of screed battens. The average thickness of the mortar bed shall be 20mm. The granite slab shall be wetted before placing in position and levelled. The joints shall be paper thin joint. Joints shall be treated with white cement mixed with matching pigment. The exposed edges of the granite slab shall be rounded / edge polished.

The facia shall also be of the same quality, but of 10mm thick as the slab over the counter and fixed with brass clips and adhesive over a base mortar of 12mm thick in cement mortar 1:3 (1 cement 3 coarse sand) the joints shall be paper thin. The slab and the facia shall be rubbed clean and polished with steel wool to give a smooth and shining surface. The slab over the counter and tiles facia shall be measured individually in Sqm

# SPECIFICATION

# FOR

# TERRACING, DAMP PROOF COURSE AND

# WATER PROOFING TREATMENT

**11.0 Terracing**

**11.1 Lime Terracing**

The roof slab shall be cleaned of all foreign material and parent slab exposed by chipping off laitance and cleaned with water and kept wet for at least six hours.

Two parts of well slaked lime obtained from an approved source and two parts of surkhi and seven parts of well burnt red brick bats 50mm down grade or in the proportion (if) specified in the item shall be mixed dry by turning over the ingredients several times. Water shall then be added in measured quantities and mixing shall be continued until the mass is uniform in colour and consistency. The concrete shall be laid to specified grade and thickness and beaten in approved manner with suitable wooden beaters for a minimum period of seven days, employing daily 2.5 beaters for every 10 Sqm. of area, adding lime water mixed with extracts of kadukkai, bel and jaggery, as required to improve the water proofing quality of the surface, which shall be kept wet and the beating continued till the concrete has been thoroughly compacted and the surface becomes hard, making the wooden beater rebound with a metallic sound. A coat of thick lime slurry mixed with crude or mustard oil shall then be rubbed well and uniformly into the surface.

The surface shall then be covered with straw and kept wet for at least four weeks. A ghundy curving of about 10cm radius shall be formed at the junction of the roof and the parapet as directed during the beating of the lime terracing. The top edge of this ghundy at its junction with the parapet shall be protected by brick or concrete over sailing course and finished with a drip mould along the underside as directed. No separate payment shall be made for the over sailing course unless separate provision has been made in the bill of quantities.

**11.2 Clay Terracing**

The roofs shall be paved with tile bricks laid flat and grouted with cement mortar.

**11.2.1 Tile Bricks**: The bricks of 4cm height shall be moulded without frogs. Where modular tiles are not freely available in the market, the tile bricks of F.P.S. thickness 44mm (1.75" ) shall be used unless otherwise specified.

**11.2.2 Cement Mortar**: The cement mortar shall be of 1:3 mix and of fine sand unless otherwise specified in the description of the item.

**11.2.3 Preparing the Surfaces:** The surface shall be hacked, roughened and cleaned of all dust and other foreign matter. It shall then be wetted before applying the mortar.

**11.2.4 Paving and Grouting**: Cement mortar shall be spread in 12mm layer over the surface evenly and to required slope. Tile bricks, which has been soaked as in brickwork in water

for at least an hour before, shall then be laid open jointed and flat on the mortar and lightly pressed, and set to plane surface true to slope, etc. using a trowel and wooden straight edge. The tile bricks shall be laid with their longitudinal lines of joints truly parallel and horizontal and at right angles to the slopping edges of the roof.

Transverse joints in alternate rows shall come directly in line with one another. Transverse joints in adjacent courses shall not break joints by less than 5cm. As soon as the paving is done, the open joints shall be grouted with cement mortar 1:3 (1 cement: 3 fine sand). Cement used for grouting mortar shall be mixed with 2% (by unit of cement) waterproofing compound conforming to IS: 2645. Care shall be taken to see that no joints are left unfilled or inadequately filled. The joints shall be finished flush with the brick surface.

**11.2.5 Curing**: The tile paving shall be cured for at least 7 days during which period it shall be suitably protected from damage.

**11.3 Damp Proof Course**

It shall consist of 1:1.5:3 plain cement concrete with approved water proofing material such as 'CICO' or 'IMPERMO' added 3% by weight of cement of specified thickness. Edges of damp proof course shall be straight, even and vertical. Side shuttering shall consist of wooden or steel forms and shall be strong and properly fixed so that the course does not get disturbed during compaction and mortar or cement slurry does not leak through. When forms are struck the surface shall be smooth without any honey combing. The surface shall be kept wet for seven days.

Before commencing the superstructure work, the top of the damp proof course shall be cleaned thoroughly and dried. Blown type bitumen shall then be applied uniformly on the surface and side of the concrete coming in contact with flooring on the inside shall also be painted with bitumen.

Instead of concrete, Shahabad, Tandur or Granite stone of specified thickness and full width in one piece may also be used. Stones shall be set in 1:3 cement mortar mixed with approved waterproofing material. After curing, the surface shall be treated with hot bitumen as specified above.

**11.4 Water Proofing Treatment**

Unless otherwise specified, the Tenderer shall carryout water proofing treatment of basements, terraces and water retaining structure through a reputed firm having expertise in the line and whose name is approved by the architect. The Tenderer shall also furnish full details of such treatment to the Engineer and provide all information / proof regarding the effectiveness, etc. about the treatment when called upon to do so.

All such treatment shall be guaranteed in the form approved by the employer for a minimum period of ten years. Any defects / leakage noticed during the guarantee period shall be rectified free of cost by the Tenderer including reinstating the surface to its original condition and finish.

Water proofing of sunk portions of floor slabs for baths, W. C. s and kitchen mories, etc. in residential buildings, unless otherwise specified, shall be done as specified in the schedule and shall generally consist of

(i) A coat of hot bitumen, minimum 6mm thick screeded with stone grit.
(ii) Minimum 20mm thick cement plaster in cement mortar 1:3 with approved waterproofing cement compound as per manufacturer's specifications. The plaster shall be cured by ponding for seven days.

The rate for the above treatment shall include cost for drying and cleaning surfaces free of dust, etc. and wiping with kerosene before application of bitumen. The vertical faces and returns shall also be treated similarly. The actual area treated including vertical faces and returns shall be measured and paid for.

# SPECIFICATION

# FOR

# PLASTERING AND POINTING

## 12.0 Plastering and Pointing

### 12.1 Materials

Cement, sand, water and combinations shall conform to material specifications given in **2.0 to 2.3**.

### 12.2 Workmanship

#### 12.2.1 Preparation of Background Surface

The surface shall be cleaned off of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surfaces shall be roughened by wire brushing or hacking for non hard and hard surfaces respectively. Projections on surface shall be trimmed wherever necessary to get even surfaces. In case of brick / stone masonry, raking of joints shall be carried out wherever necessary. The masonry shall be allowed to dry out for sufficient period before carrying out the plaster work, the masonry shall not be soaked but only damped evenly thereafter before applying the plaster.

In case of concrete work, projecting burrs of mortar formed due to the gaps of joints in shuttering shall be removed. Such surface shall be scrubbed clean with wire brushes. The surface shall be pock marked with a pointed tool at spacing of not more than 50mm centers, the pocks being made not less than 3mm deep to ensure a proper key for the plaster. The surface shall be washed off and cleaned of all oil, grease, etc. and well wetted before the plaster is applied.

#### 12.2.2 Sequence of Operations

For external plaster, the plastering operations shall be started from the top floor and carried downwards. For internal plaster, the plastering may be started wherever the building frame, roofing and brickwork are ready.

The surface to be plastered, shall first be prepared as described in Preparation of Background Surface in **Clause 12.2.1**.

The first underlay shall then be applied to ceilings. After the ceiling plaster is complete and scaffolding for the same is removed, plastering on wall shall be started.

After a suitable time interval as detailed under various types of plaster in subsequent paras, depending upon the type of mortar, the secondary layers if required shall be applied. After a further suitable time interval as detailed under various type of plaster in subsequent paras, the finishing coat shall be applied first to the ceiling and then to the walls.

Plastering of cornices, decorative features, etc. shall be completed before the finishing coat is applied. Unless otherwise specified, corners and edges shall be rounded off to a radius of 25mm, such rounding off shall be complete along with the finishing coat to prevent any joint marks showing out later.

#### 12.2.3 Scaffolding / Staging

Scaffolding / staging for plastering / pointing shall be as per Specification for Brick Masonry, **Clause 8.1.3.5**.

**12.2.4 Damage Rectification**

Any cracks, damages, any part of work which sound hollow when tapped or found damaged or defective otherwise shall be cut out in rectangular shape and redone as directed by Engineer.

**12.3 Plain Cement Plaster**

**12.3.1 Preparation of Mortars**

The mortars of specified mix shall be used as per the specifications of 'Cement Mortar' described **8.1.2.2**.

**12.3.2 Application of Plaster**

**12.3.2.1One Layer Plaster Work**

To ensure even specified thickness, plaster of 150mm X 150mm shall be first applied horizontally and vertically at not more than 2m interval over the entire surface to serve as gauges. The surface of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall be brought to true surface by working with a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally the surface shall be finished off true with a trowel or wooden float to obtain a smooth texture. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical, horizontal and shall be carefully finished. Rounding or chamfering of corners, arises, junctions, etc. shall be carried out with proper templates to the size required.

In suspending the work, the plaster shall be left, cut clean to line, both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped clean and wetted before plastering the adjoining area. Plastering work shall be closed on the border of the wall and nearer than 150mm to any corners or arises and shall not be closed on the body of the features such as plaster bands, cornices nor at the corners or arises.

**12.3.2.2Two Layers Plaster Work**

**a. First or Under layer**

The first or under layer of the specified thickness shall be applied as described in **Clause No. 12.3.2.1**. Before the first coat hardens, surface of it shall be beaten up by edges of wooden tapers and close dents shall be made on the surface.

The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

**b. Second or Finishing Layer**

The second layer shall be complete to the specified thickness in the same manner as for first layer.

**12.3.2.3 Curing**

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of 7 days. During this period, the plaster shall be suitably protected from all damages at the Tenderer's expense by such means as approved by the Engineer. The date of execution of plastering shall be marked on the plastering to ensure the proper duration of curing.

### 12.4 Sand Face Plaster

#### 12.4.1 Preparation of mortar

The mortar of specified mix shall be used as per the specifications of cement mortar described in **Clause No. 8.1.2.2**.

#### 12.4.1.1 Application of Plaster

Sand face plaster shall consist of 13mm thick (1 cement: 4 coarse sand by volume) under layer and 7mm thick (1 cement: 2 coarse sand by volume) top layer. Application of plaster shall be as described in two coat plaster work in **Clause No. 12.3.2.2.b**.

The surface of the sand face plaster shall be finished rough with sponge or as directed by the Engineer.

#### 12.4.1.2 Curing

Curing shall be as described in **Clause No. 12.3.2.3**.

#### 12.4.2 Exposed Aggregate Finish Plaster

#### 12.4.2.1 Preparation of Mortar

The mortar of specified mix shall be used as per the specifications of cement mortar d described in **Clause No. 8.1.2.2**. White and coloured marble chips shall be of 6mm to 12mm size out of Makrana / Ambaji, grade 1 or Dongri Chittor Brown / Rajnagar / Abu green, grade 1 quality. Marble dust shall be obtained from crushing hard marble stone, it shall not be less than 1.0.

#### 12.4.2.2 Application of Plaster

Exposed aggregate finish plaster shall consist of 12mm thick plain cement plaster under layer (1 cement: 4 coarse sand by volume) finished rough and 20mm thick top layer (Under layer shall be applied in accordance with 'One layer plaster work' described in Clause No. 12.3.2.1).

Top layer shall be 20mm thick admixture of white cement and grey cement (mix ratio 1:1 by volume) mixed with white / coloured marble chips / pebbles of 6mm to 12mm nominal size as per item description. Mix ratio shall be 1 cement: 1 marble chips / pebbles by volume. Marble dust at 15% by volume shall be added to the admixture. The pebbles to be used shall be well washed and drained. The admixture shall be thrown wet on the under layer while it is still plastic using strong whipping motion at right angles to the face of the wall. One coat of neat cement slurry at 2.75 kg cement per Sqm. of area shall be applied on to the under layer to receive the top layer. The whole plastering laid in panels as per drawing with 12mm X 20mm grooves in between formed by holding removable wooden battons of 12mm X 25mm size over the under layer.

The top layer admixture pressed flat over the under layer filling uncovered parts by hand, so that the finished surface represents a homogeneous surface. Loose mortar, etc. on the top surface shall be cleaned / removed by brushing / washing / spraying with water jet after initial setting of mortar.

#### 12.4.2.3 Curing

Curing shall be as described in **Clause No.12.3.2.3**.

### 12.5 Pointing

Pointing shall be of the type specified such as flush, cut or weather struck, raised and cut, etc.

**12.5.1 Preparation of base surface**

The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall be less than 20mm.

**12.5.2 Mortar**

Mortar shall be in accordance with the specifications of cement mortar described in **Clause No. 8.1.2.2**.

**12.5.3 Application of mortar and finishing**

The mortar shall be pressed into the raked out joints with a pointing trowel according to the type of pointing specified, the mortar shall be spread over the corner edges or surfaces of the masonry. The pointing shall then be finished with the pointed tool. The superfluous mortar shall be cut off from the edges.

**12.6 Flush pointing**

The mortar shall be pressed into joints and shall be finished off flush and leveled. The edges shall be neatly trimmed with trowel and straight edges.

**12.7 Cut or Weather Struck Pointing**

The mortar shall first be pressed into joints, the top of the horizontal joints shall then be neatly pressed back by about 15mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall also be similarly pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles incase of brick and course rubble masonry.

**12.8 Raised and Cut Pointing**

This type of pointing shall project from the wall facing with its edges cut parallel so that to have a uniformly raised band about 6mm and width 10mm more as directed. The pointing shall be finished to a smooth but hard surface.

**12.9 Curing**

Curing shall be as described in **Clause No.12.3.2.3**.

**12.10 Plastering**

Thickness of the plaster shall be the minimum thickness at any point on a surface and shall be exclusive of the key i.e. grooves or open joints in masonry. No extra payment shall be allowed for extra thickness of plaster done by Tenderer, drip moulds, rounding of edges making grooves, etc.

All plastering / pointing shall be measured in Sqm. unless otherwise specified. Length, breadth, height shall be measured correct to 0.1m. Soffits of stairs shall be measured as plastering on ceiling. Ceiling with projected beams shall be measured over beams and plastered side of beam shall be measured and added on ceiling.

**12.11 Deductions and Additions shall be made in the following manner**

No deductions shall be made for ends of joists, beams, posts, openings not exceeding 0.5 Sqm. area and no addition shall be made for reveals, jambs, soffits, etc. of these openings mortar finish to plaster around ends of joists, beams, posts, etc.

Deductions for openings exceeding 0.5 Sqm. but not exceeding 3 Sqm. shall be made as follows and no addition shall be made for reveals, jambs, soffits, etc. of these openings.

- When two faces of wall are plastered with different types of plasters or if one face is plastered and the other pointed, deduction shall be made from the plaster or pointing on the side of frame for door, window, etc. on which width of reveals in less, but no deduction shall be made on the other side. Where widths of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made.

- When only one face is plastered, full deduction shall be made from plaster if width of reveal on plastered side is less. But if width of reveal on both sides are equal or more on unplastered side, no deduction shall be made.
- In case of openings of area above 3 Sqm., deduction shall be made for openings but jambs, soffits and sills shall be measured.

**12.12 Pointing**

Pointing shall be measured in square meter and deductions shall be done in accordance with **Clause No. 12.11**.

**12.13 Providing and Fixing Chicken Wire Mesh**

The wire mesh shall be of 24 gauge and it shall be fixed with nails at the junction of brick masonry and RCC elements. The chicken wire mesh shall not sag in between the nails. This shall be done before the application of plaster.

**12.14 Providing and Applying Rough Cast Plaster**

This shall be carried out in two layers. The base plaster shall be of 22mm thick and of specified proportion of CM. It shall be roughened to receive the top layer. The top layer shall be 7mm thick. It shall be of 3 parts cement, 6 parts coarse sand & 4 parts of 6mm to 10mm single or crushed stone aggregate. The plaster shall be cured at least for 7 days.

**12.15 Providing and Applying Water Proof Cement Plaster**

The plaster shall be of specified thickness and of mortar proportions. The Tenderer shall use approved waterproofing admixture made by reputed manufacturer in the mortar for plaster work. The quantity to be used shall be in accordance with the manufacturer's instructions, however subjected to the approval of the Engineer. The use of calcium chloride shall be prohibited unless specifically allowed by the Engineer and shall conform to IS: 2645. The plaster shall be cured at least for 7 days.

# SPECIFICATION

# FOR

# WHITE WASHING, COLOUR WASHING,

# DISTEMPERING, PAINTING AND

# POLISHING

## 13.0 White Washing, Colour Washing, Distempering, Painting and Polishing

**13.1 General**

Reference shall be made to the following Indian Standards.

| | |
|---|---|
| **IS: 6278** | **Code of practice for white washing and colour washing.** |
| **IS: 2395** | **Code of practice for painting concrete, masonry and plaster surfaces.** |
| **IS: 712** | **Specification for building limes.** |
| **IS: 55** | **Specification for Ultramarine blue for paints.** |

| | |
|---|---|
| **IS: 63** | **Specification for whiting for paint and putty.** |
| **IS: 427** | **Distemper (dry) colour as required.** |
| **IS: 428** | **Distemper (Oil bound) colour as required.** |
| **IS: 5411** | **Specification for plastic emulsion paint for interior use.** |
| **IS: 2338** | **Code of practice for finishing of wood and wood (Part I, II) based Materials** |
| **IS: 5410** | **Cement paint, colour as required.** |
| **IS: 2524** | **Code of practice for painting non ferrous metals in buildings** |
| **IS: 384** | **Brushes, paints and varnishes, flat.** |
| **IS: 486** | **Brushes, sash, tool for paints and varnishes** |
| **IS: 110** | **Ready mixed paint, brushing, grey filler enamels for use over primers.** |
| **IS: 426** | **Paste filler for colour coats.** |
| **IS: 345** | **Wood filler, transparent liquid** |
| **IS: 3585** | **Ready mixed paint, aluminium brushing priming water resistant for woodwork.** |
| **IS: 426** | **Paste filler for colour coats.** |
| **IS: 106** | **Ready mixed paint, brushing, priming for enamels, for use on metals.** |

All materials required for the execution of painting work shall be obtained direct from approved manufacturers and shall be brought to the site in makers drums, keys, etc. with seals unbroken.

In case of ready mixed paints, thinning, if necessary, the brand of thinner shall be as per recommendations of the manufacturer.

Paint shall be applied by brushing or spraying. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer. During painting, every time after the paint has been worked out of the brush bristles, the bristles shall be opened up by striking the brush suitably.

Spray machine used may be of high pressure type or low pressure depending on the nature and location of work. After work, the brushes shall be completely cleaned off paint and shall be hung in a thinner if intended to be used afterwards. The spray guns shall be cleaned thoroughly after every break in work. The paint containers, when not used shall be kept close and free from air.

After the finishing of work, the adjacent surfaces not intended to be washed / distempered / painted / polished, shall be thoroughly cleaned off of all paint patches and shall be finished in accordance with surface finishing of such surfaces.

### 13.2 White washing

White washing in general shall conform to IS: 6278.

### 13.2.1 Workmanship

#### 13.2.1.1 Scaffolding

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white / colour washed. For white washing of ceiling, proper stage scaffolding shall be erected.

#### 13.2.1.2 Preparation of Surfaces

The surface shall be thoroughly cleaned of all dirt, dust, mortar dropping and other foreign matter before white wash is to be applied.

All holes, cracks, patches, etc. not exceeding 0.1 Sqm. in area shall be made good with material similar to that of the surface. Surface affected by efflorescence, moss, fungi, algae, lichen, etc. shall be treated in accordance with IS: 2395.

#### 13.2.1.3 Preparation of White Wash

Pre prepared lime wash like "Janata Cem" may be used with prior approval of the Engineer.

**13.2.1.4 Application**

White wash shall be applied with brush to the specified number of coats. The operation for each coat shall consist of stroke of the brush from top to downwards, another from down to upwards over the first stroke, similarly one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied.

The white washing on ceiling should be done prior to that on walls.

**13.2.1.5 Protective Measures**

Surfaces of doors, windows, floors, etc., which are not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned off of white wash splashed, if any.

## 13.3 Oil bound distempering

### 13.3.1 Workmanship

**13.3.1.1 Scaffolding**

Same as in **Clause No. 13.2.1.1**.

**13.3.1.2 Preparation of surface**

Pre surface shall be thoroughly brushed free from dust, grease, mortar dropping, other foreign matter and shall be made smooth by sand papering upto the satisfaction of the Engineer and unevenness shall be made good by applying putty made of plaster of paris mixed with water including filling up the undulation and then sand papering the same after it is dry.

**13.3.1.3 Primer coat**

The primer coat shall be alkali resistant primer or distemper primer and shall be of the same manufacture as oil bound distemper.

If the wall surface plaster has not dried completely, alkali resistant primer otherwise distemper primer shall be applied. The mixture of alkali resistant primer shall be prepared as per approved manufacturer's instructions.

The application of primer coat shall be in accordance with **Clause No. 13.2.1.4**.

**13.3.1.4 Preparation of Oil Bound Distemper**

The distemper shall conform to IS: 428 and shall be diluted with water or any other prescribed thinner recommended by the manufacturer.

**13.3.1.5 Application of distemper**

After the priming coat has dried for at least 48 hours, the surface shall be lightly sand papered and dusted off avoiding rubbing off of the priming coat.

Prepared distemper shall then be applied in minimum two coats with proper distemper brushes in horizontal strokes immediately followed by vertical ones, which together shall constitute one coat. The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform without patches, marks, distemper drops, etc. The application of a coat in each room shall be finished in one operation. After each days work, brushes shall be thoroughly washed in hot water and hung down to dry.

**10.3.1.6 Protective measure**

Same as in **Clause No. 13.2.1.5**.

## 13.4 Waterproof cement paint

**13.4.1 Workmanship**

**13.4.1.1 Scaffolding**

Same as in **Clause No.13.2.1.1**.

**13.4.1.2 Preparation of Surface**

Preparation of surface shall in general be in accordance with **Clause No.13.2.1.2** except that any unevenness shall be made good by applying putty made of plaster of paris mixed with water including filling up the undulation and then sand papering the same after it is dry.

**13.4.1.3 Primer Coat**

The primer coat of cement primer of same manufacture as the cement paint shall be applied as in **Clause No. 13.2.1.4**.

**13.4.1.4 Preparation of Paint**

Waterproof cement paint of approved make shall be mixed with water and stirred to obtain a thick paste which shall then be diluted to brushable consistency. The proportion of mixture shall be as manufacturer's recommendation. The paint shall be mixed in such quantity which can be used up within an hour of mixing to avoid setting and thickening of the paint.

**13.4.1.5 Application of Paint**

The surface shall be treated with minimum two coats of waterproof cement paint. No less than 24 hours shall be allowed between two coats and the subsequent coats shall be applied only after the preceding coat has become hard to resist marking by subsequent brushing.

The finished surface shall be even and uniform in shade without patches, brush marks, paint drops, etc. Cement paints shall be applied with a brush with relatively short stiff hog of fibre bristles.

**13.4.1.6 Curing**

Curing shall be started after the paint has hardened. Curing shall be done by sprinkling with water two or three times a day. This shall be done between coats and for at least two days following the final coat.

**13.4.1.7 Protective Measure**

Same as in **Clause No. 13.2.1.5**.

**13.5 Acrylic Emulsion Painting**

**13.5.1 Workmanship**

**13.5.1.1 Scaffolding**

Same as in **Clause No. 13.2.1.1**.

**13.5.1.2 Preparation of Surface**

Same as in **Clause No. 13.2.1.2** under specification of oil bound distempering.

**13.5.1.3 Preparation of Mix**

Plastic emulsion paint shall conform to IS: 5411 (Part – 1) and shall be of approved shade. Preparation of mix shall be as per manufacturer's instructions.

**13.5.1.4 Application of Paint**

The paint mix shall be continuously stirred while applying for maintaining uniform consistency. Number of coats shall be as per item description. The painting shall be laid evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first, then brushing alternately in opposite direction 2 / 3 times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks, no hair marks no clogging of paint puddles shall be permitted. The full process of crossing and laying off shall constitute one coat.

The paint shall be applied by means of brush or roller.

Before starting painting with plastic emulsion paint, the prepared surface shall be treated with two coats of primer consisting of cement primer, whiting and plastic emulsion paint shall start only after the preceding coat has become sufficiently hard to resist brush marking. Subsequent coats of plastic emulsion paint shall also be started after the preceding coat is dried by evaporation of water content.

The surface on finishing shall present a flat, velvety smooth finish, even and uniform shade without patches, marks, paint drops, etc.

**13.5.1.5 Precautions**

i) Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush. Old brushes, if used, shall be completely dried of turpentine oil / paints by washing in warm soap water.

ii) No oil base putties shall be used in filling cracks / holes.

iii) Washing of painted surface shall not be done within 3 – 4 weeks of application.

**13.5.1.6 Protective measures**

Same as in **Clause No. 13.2.1.5**.

## 13.6 Acrylic Copolymer Aggregate Finish

### 13.6.1 Material

It shall be an acrylic based textured wall coating consisting of quartz and silica aggregate, inorganic pigments and other additives to form a crack free, flexible, tough, waterproof coating.

### 13.6.2 Preparation of Surface

The surface to be coated shall be cleaned off of all dirt, dust, grease and loose particles. Any old textured surface shall be removed with removing agent as per manufacturer's instructions.

### 13.6.3 Application

Bonding agent and water shall be mixed first. Then the flakes / granules shall be added and mixed thoroughly and kneaded till no lumps are found. The dough shall be left for 20 – 30 minutes before starting application. The bonding agent, flakes / granules and water shall be mixed in different ratios for different finishes as per manufacturer's specifications.

The first application shall be by steel trowel. It shall be smoothened, if the specified finish requires, by a plastic trowel.

## 13.7 Painting Wood and Wood Based Material

**Synthetic Enamel Paint:** It shall conform to IS: 2932 of approved brand and colour.

### 13.7.1 Preparation of Surface

Preparation of surface shall conform to IS: 2338 (Part – 1) in general. All woodwork shall be dry and free from any foreign matter. Nails shall be punched well below the surface. The surface shall be smoothened off with abrasive paper used across the grain prior to painting with the grain prior to the staining. Any knots, resinous or bluish sap wood, cutting out of which is not justified shall be covered with red lead conforming to IS: 103.
Plywood and block board shall be treated in the same manner as for wood work.
Particle board surface shall be filled with a thin brushable filler and finished as for solid wood.

**13.7.2 Priming**

Priming shall be in accordance with IS: 2338 (Part I and II). Dirt or any other extraneous material on the surface shall be removed and the priming shall be applied by brushing.
Priming shall be done on all exposed and unexposed surfaces. Unless specific otherwise, all joinery work intended to be painted shall receive at least 2 coats of primer.
Type of primer shall be in accordance with Table – 1and Table – 2 of IS: 2338 (Part – II).

**13.7.3 Stopping and Filling**

Stopping and filling shall be done after priming. Stopping shall be made to the consistency of stiff paste and shall be used to fill holes and cracks. Filler shall be used to level up slight irregularities of the surface. Filler shall be applied with a putty knife and subsequently rubbed down to a level surface with abrasive paper.
The filler coat shall be allowed to fully flatten and harden before subsequent coat is applied.

**13.7.4 Application of Under Coat**

Under coat shall be applied after the surface has been primed, stopped and filled, and rubbed down to a smooth surface. Under coat may be brushed or sprayed. After drying the coat shall be carefully rubbed down and wiped clean before the next coat is applied.
The type of under coat shall depend upon the finishing and in accordance with Table – 1 and Table – 2 of IS: 2338 (Part – II).

**13.7.5 Finishing**

The finishing paint shall be as specified in the item description and shall be applied either by the brush or by spraying.
Reference shall be made to the Table – 1 and Table – 2 of IS: 2338 (Part – II).

**13.7.6 Application of Clear Finishes**

For the application of clear finishes, the following procedures shall generally be adopted in accordance with IS: 2338 (Part – I)

i) Filling
ii) Staining
iii) Sealing
iv) Finishing

**13.7.6.1 Filling**

Fillers shall be applied to prevent the excessive penetration of the finish to the surface for obtaining a smooth finish. Fillers shall conform to IS: 345.
Fillers shall be heavily applied to the wood surface by hand, using hessian or jute rag across the grain. It shall be rubbed when still wet to get better penetration. After 5 – 10 minutes, it shall be wiped off by hand across the grain followed by a light wipe with the grain. The filled surface shall be dried preferably over night and smoothened with abrasive paper.

**13.7.6.2 Staining**

**a. Spirit Stains**

Spirit stains are solutions of spirit soluble dyes in industrial methylated spirit.

**b. Oil Stains**

Oil stains are solutions of oil soluble dyes in linseed oil, but usually consist of insoluble, semi transparent pigments ground in linseed oil and thinned with turpentine or other solvent.

**c. Preparation of Wood for Staining**

Surface intended for staining shall be kept scrupulously clean and free from greasy finger marks. It shall be prepared by careful smoothening with fine abrasive paper used in the direction of the grain.

Small cracks / nail holes shall be stopped with plastic wood / fine plaster of paris. The stopping shall be rubbed down with fine abrasive paper when hard and touched with a thinned knotting before staining. In case of oil staining, stopping shall be done after staining using tinted putty or wood filler.

**d. Application of Stains**

Stains shall be applied by brushing, and wiping or by spraying. The stain shall be so thinned that it can be applied fairly, liberally without over staining and over lapping.

**13.7.6.3 Sealing**

A suitable sealer shall be applied on the filled and sanded surface to prevent absorption by the wood of the succeeding coats of finish and to seal stain and filler and thus preclude their bleeding into the finish coat.

Sealer may be sprayed on taking care not to flood the surface and it shall be allowed to dry hard.

When fully dry, the surface shall be sanded taking care of not to cut through at corners and edges. Dust shall be blown off and surface wiped with a clean rag.

**13.7.6.4 Finishing**

The stained surface shall be varnished, wax polished or french polished as required after it is dried.

**13.7.7 Varnishing**

Varnishing of wood and wood based material shall be in accordance with IS: 2338 (Part – I).

Surfaces to be varnished shall be prepared to produce a smooth, dry and matt surface and all dust and dirt shall be removed from the surface.

The varnish, shall be applied liberally with a brush and spread evenly over a portion of the surface with short light strokes to avoid frothing. It shall be allowed to flow out while the next section is being laid in. Excess varnish shall be scrapped out of the brush and then the first section be crossed, re – crossed and laid off lightly. The varnish, once it has begun to set, shall not be retouched in case of any mistake, the varnish shall be removed and the work shall be started afresh.

Where two coats of varnish are applied, the first coat shall be a hard drying under coating or flatting varnish, which shall be allowed to dry hard and then be flattened down before applying the finishing coat. Sufficient time shall be allowed in between two coats.

When flat varnishing is used for finishing, a preparatory coat of hard drying undercoating of flatting varnish shall first be applied and shall be allowed to harden thoroughly. It shall then be lightly rubbed down before the flat varnish is applied. On larger areas, the flat varnish shall be applied rapidly and the edges of each patch applied shall not be allowed to set, but shall be followed up whilst in free working conditions.

**13.7.8 French Polish**

French polish shall conform to IS: 348. Suitable pigments shall be added to get the required colour.

The surface to be french polished shall be rubbed down to smoothness with sand paper and shall be well dusted. Pores in the surface shall be filled up with fillers.

A pad of woolen cloth covered by a fine cloth shall be used to apply the finish. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil may be used on the face of the pad for the purpose. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean, fine cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

**13.8 Painting of steel and other metal surface**

**13.8.1 General**

Reference shall be made to the following Indian Standards IS: 2524, IS: 1447.

**13.8.2 Preparation of surface**

The surface, before painting shall be cleaned off of all rust, scale, dirt and other foreign matters with wire brushes, steel wool, scrappers, sand paper, etc. The surface shall then be wiped finally with mineral turpentine, which shall then be removed of grease, etc. The surface then shall be allowed to dry. In case of GI surface, surface so prepared shall be treated with Mordant Solution (5 litres for about 100 Sqm.) by rubbing the solution generously with brush. After about half an hour, the surface if required shall be retouched and washed down thoroughly with clean cold water and allowed to dry.

**13.8.3 Application of Priming and Paints**

Approved quality primer and paint in specified no. of coats shall be applied as per manufacturer's recommendations either by brushing or spraying. Each subsequent coat shall be applied only after the preceding coat is dried.

**Measurement and Rate (where painting is not included in the relevant description of item in the bill of quantities)**

All work shall be measured in areas. Areas shall be worked out to the nearest 0.01 Sqm. and all dimensions to the nearest 0.01m.

Deductions shall be made in accordance with IS specification. For method of measurements the equivalent area shall be worked out in accordance with IS: 1200. The rate shall include the cost of all materials, labour, scaffolding, protective measures, etc. and all works involved in specification. The rate shall also include, if not mentioned otherwise, conveyance, delivery, handling, unloading, storing, etc.

# SPECIFICATION

# FOR

# MISCELLANEOUS WORKS

## 14.0 Miscellaneous

### 14.1 Barbed Wire Fencing – RCC Posts

These specifications define the materials and construction aspects of barbed wire fencing with RCC posts.

### 14.1.1 Materials

All RCC posts and struts shall be of standard size, the length of posts being 1.8m or as specified and that of struts being minimum of 2.0m. These shall be cast in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5mm nominal size) reinforced with 6mm diameter mild steel bars as directed and finished smooth with cement mortar 1:2 (1 cement : 2 fine sand). The specifications for RCC work shall apply. The posts and struts shall be free from cracks, twists and such other defects GI staples on wooden plugs or 6mm barbing will be provided as directed by the Engineer while casting the posts. Barbed wire shall be as per IS: 278. The spacing of posts shall be as specified in drawings or as directed by the Engineer to suit the dimensions of the area to be fenced. Every 15$^{th}$, last but one end post and corner posts shall be strutted on both sides and end posts on one side only.

### 14.1.2 Fixing of Posts and Struts

Pits 45cm X 45cm and 75cm deep or as directed shall first be excavated true to line and level to receive the posts. In the case of struts, pits 70cm X 45cm X 75cm deep or as directed shall be excavated to suit the inclination of the strut so that it is surrounded by concrete by not less than 15cm at any point. The pits shall be filled with a layer of 15cm thick cement concrete 1:3:6 (1 cement :3 fine sand : 6 graded stone aggregate 40 nominal size). The posts and struts shall then be placed in the pits, the posts projecting 1.2m or to the specified height above ground, true to line and position. The cement concrete 1:3:6 shall be filled in upto 15cm for posts and 25cm for struts below ground level at the base of the concrete so that the posts are embedded in the cement concrete block of size 45cm X 45cm X 60cm and strut in block of size 70cm X 45cm X 50cm. The concrete in foundations shall be watered for at least 7 days and shall be filled up with excavated earth and the surplus earth disposed off as directed by the Engineer.

### 14.1.3 Fixing Barbed wire

The barbed wire shall be stretched and fixed in specified number of rows and two diagonals. The bottom row shall be 14cm above ground and the rest at 12.5cm c/c. The diagonals shall be stretched between adjacent posts from top wire of one post to the bottom wire of the second post. The diagonal wires shall be interwoven with horizontal wires by fixing the odd rows of wires, then the diagonal cross wires and lastly the even rows of wires. The barbed wire shall be held to the RCC posts by means of GI staples

fixed to wooden plugs or GI bindings wire tied to 6mm barbing fixed while casting the posts. Turn buckles and straining bolts shall be used at the end posts, if so specified.

**14.2 Barbed Wire Fencing – Mild Steel Angle Posts over Masonry Compound Walls**

These specifications define the materials and construction aspects of barbed wire fencing with MS angle posts. MS angle shall be 50 X 50 X 6mm or as specified, conform to IS: 1852 where 2 angles are specified for a single support. It shall be welded continuously and fixed on masonry walls as specified. The barbed wire shall be as per IS:278. The fixing of barbed wire shall be as per **Clause No. 14.1.3**. The wire shall be held by tearing holes of 10mm dia in the post and tied with GI wire.

**14.3 Chain link fencing**

Fencing shall be provided as per BOQ and drawings and includes the following item of works.

a) Providing specified gauge and shapes of mesh woven galvanized chain link fencing, fixed with 6mm dia bar on each angle iron columns duly clamped and hooked with 6 mm dia 'J' bolts, nuts, washers, etc.
b) Providing, stretching and fixing of three rows of 3mm dia GI wire to woven chain link fencing.
c) Painting MS bar with 2 coats of primer and 2 coats of aluminium paint of approved make and shade as per our specification.
d) Item includes iron angle or concrete poles, earth work, foundation concrete and masonry work, etc. as shown in drawing / described in BOQ
e) Measurements shall be for running meter of work completed.

**14.4 Ferro Cement Water Tank**

The ferro cement is made up of 8 SWG 100 X 100 weld mesh formed to shape of tank and covered by two layers of 25mm size 22 SWG chicken mesh as the skeleton fixed with couplers for inlet / outlet overflow / scour pipes of 25mm dia at appropriate locations. The skeleton is coated over with cement mortar 1:2 (1 cement : 2 fine sand) added with 3% waterproofing admixtures like cico and finished in layer to line and level. The walls and base shall be integral and the cover movable as one or two pieces. The base shall have additional layer of weld mesh as above with suitable anchorage with the shell. The tank shall be painted inside with anti fungal paint. Overflow and vent connections shall be provided with mosquito proof wire mesh couplings, the cost shall include all items and fixing. The price quoted shall be for unit of tank inclusive of all reinforcement mesh fixtures, supports and all finishes except decorative painting. The skeleton in mesh may be made elsewhere but casting of tank shall be on the terrace at the final location. Transporting the casted tank is not suggested and is to be avoided.

**14.5 Road Signs**

**14.5.1 Name Board Fixing**

The name board post of standard design shown in figure shall be firmly fixed in ground to a depth of 75 cm. The side filling shall be thoroughly watered and consolidated. Boards shown in figures shall be firmly fixed in ground in cement concrete 1:3:6 (1 cement; 3 fine sand; 6 graded stone aggregate 40 mm nominal size) which shall be paid for separately.

**14.5.2 Painting**

Exposed surface above ground shall be painted with white zinc paint in two or more coats over a coat of primer, as for new work.

**14.6 Reinforced Earth**

This is done generally for retaining cohesive soils by a composite wall consisting of a façade in concrete, back ties in concrete of corrosion resistant steel or polypropylene net or stirrups and filled up cohesive soil.

**14.6.1 Materials**

The façade may be concrete blocks or reinforced concrete panels in inter locked shapes. The ties backwards shall be in lengths depending on the height of all. Cohesive soils shall be gravel with clay content consolidated in layers after spreading the ties.

**14.6.2 Designs**

The retaining wall is expected to derive its gravity from the composite action of the façade, ties and back fill.

- The façade itself may be continuous or by open concrete grids inter locked with ties in precast concrete.
- The design details shall be strictly according to the drawings supplied.

**14.6.3 Terracotta Jali**

The jali shall be set in position true to plum and level before the joints sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement : 3 coarse sand) sand rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jali uniformly on all sides.

The jali shall be measured for its gross superficial area. The length and breadth shall be measured correct to a cm.

The rate shall be inclusive of materials and labour involved in all the operations described above except plastering of jambs, sills and soffits, which will be paid for under relevant items of plastering.

**14.7 Anchors in Rock**

14.7.1 Rock anchors in building construction shall be employed to attach the foundation on to the sheet rock encountered on the surface or at shallow depth. The components of this work shall be

- Drilling of vertical holes into the rock.
- Providing suitable anchor rods in steel, preferably of high strength.
- Using a non shrink grout into the gap between the hole and the inserted rod.

14.7.2 The holes to be driven are preferably of 35 – 45 – 50 mm diameter into which bars of 20 / 25 / 28 mm are inserted and grouted.

Alternatively the bars are driven into the holes filled with fresh grout. The bars down the hole shall be of length of 30 to 50 diameters of bars and the free end shall have bent ends of mechanical fixtures for anchoring into the foundation concrete, which will follow. The measurements shall be taken per each hole driven, inclusive of grout and anchor bars.

**14.8 Interlock Concrete Pavers**

Supplying and laying interlock concrete pavers as per approved vendor list with M40 grade concrete blocks, with minimum thickness of 80mm and providing minimum 50mm thick sand cushion below the pavers as sub base, sand filling between the pavers and compacting the same as per directions of the Engineer's / Manufacture's specification.

- The specification for production of paver blocks as per BS 6717 – part I(for M50 grade) (i.e. 49 N/mm$^2$) For M40 – Average of samples >= 40 MPa (39 N / mm$^2$ ) Interpolated from code standards.

  No individual paver compression strength <= 32Mpa (31.40 mm$^2$ ) with relevant slope factors adopted as per BS: 617 – Part I or different thickness to arrive at correct compressive strength.

$$\text{i.e. C.C.S} = \frac{\text{Load X Relevant shape factor}}{\text{Surface area of pavers}}$$

- Laying as per BS: 6717 Part – III

**14.9 Setting of Mangalore Tiles over Concrete in Sloped Surface**

The Mangalore tiles shall be of thickness 20 mm, pressed and fired. Extruded tiles are not acceptable. Absorption of water by tiles shall not be less than 19%.

Clean and brush the slope surface and spread cement mortar 1:3 to predetermined levels. Set in tiles on this mortar pressed bard and using a wooden mallet, such that the mortar fills and bonds with serrations at the bottom of the tile. Filling in the joints by mortar shall be done from behind. Ridge and border tiles shall be laid wherever necessary.

The tiles shall set from eave upwards, taking care to avoid spillage of mortar on the set tiles. The measurement shall be for the exposed surface area. The tile so laid shall be cured for at least 7 days.

**14.10 Applying Two Coats of Bitumen 80 / 100 over D.P.C – at Plinth Level**

**14.10.1 Preparing the Surface**

The surface shall be cleaned with wire brush and cotton or gunny cloth. All loose materials and scale shall be removed and the surface further cleaned with a piece of cloth lightly soaked in kerosene oil.

**14.10.2 Painting with Bitumen**

The prepared surface shall be painted with petroleum bitumen of penetration 80 / 100 of approved quality at 17kg per 10 Sqm. impregnated with a coat of coarse sand at 60 cubic decimeter per 10 Sqm. The bitumen shall be heated to the required temperature as per specifications of the manufacture.

**14.11 Plinth Protection and Kerb Stone around the Building**

The plinth protection slab shall be of pre cast with C.C. 1:3:6 of approved size and thickness using 12mm down grade metal laid over consolidated river sand filling of 15cm depth with proper slope and the joints neatly fitted with C.M. 1:3.

Do as above for kerb stone of minimum 7.5 cm thick and size as specified with the top edge of the kerb stone flush with plinth protection slab and fixed neatly with C.M. 1:3 as per the direction of the Engineer.

**14.12 Sandtex Matt Paint**

Same specification as that of cement paint of extension surface but with sandtex matt paint finish of approved make quality and colour.

**14.13 C.I. Manhole Cover**

Cast iron frames shall be provided by the Tenderer and bedded in cement mortar on the brick work or cement concrete with splayed fillet all around and in such position that the top may be 13mm above the original surface of the road. The covers are to be placed in position and the hole left neat and dry. Cover shall be cast iron heavy duty circular pattern. They shall be coated with bituminous paint.

**14.14 Soil Stabilization**

Soil stabilization may be carried out wherever required with the approval of Engineer-in-charge-in charge by installing sand and lime piles of specified dia with approved grid and depth. The sand plus lime will be of dry mortar mixed with the proportions of 2 parts of lime and one part of river sand filled in the bore stage by stage and well consolidated. The size and spacing of the driven hole shall be as prescribed in the item.

**14.15 Under – Reamed pile**

It shall be confirm to IS: 2911 (Part III) – 1980. Under reamed piles are of bored cast – in – situ piles having one or more bulbs by suitably enlarging the borehole for the pile stem.

These piles are provided to a certain depth as per soil strata to avoid undesirable effect of seasonal moisture changes which will affect the subsoil in foundation. It is further capable of taking care of downward, upward and lateral loads and movements in foundation below ground level. The necessary mechanical devices must be used for the bore as well as scooping out the earth for the required dia and length as specified. The concrete mix and water cement ratio will be so controlled taking into consideration the subsoil water level also.

1) When the ground consists of expansive soils (black cotton soil), the bulb of under reamed pile shall be provided with anchorage against uplift due to swelling pressure.

**14.15.1 Design Considerations**

2. In deep deposits of expansive soil the minimum length of piles shall be 3.5m below ground level.
3. The dia of under reamed bulbs may vary from 2 to 3 times of stem diameter.
4. For piles upto 30cm dia the spacing of bulbs should not exceed 1.5 times the dia of bulb. For piles of dia greater than 30cm spacing can be reduced to 1.25 times the stem dia.

**14.16 Brick Jelly Concrete 1:4:8 Over Roof**

The sunken portion of toilet in first floor is treated as follows before sanitary fittings are embedded. The internal portion of the R.C. sunken floor must be plastered with C.M. 1:3 mixed with water proofing compound CICO or Impermo as approved by the Engineer at the rate of 3% by weight of cement. Then brick jelly lime concrete of 1:4:8 (using approved broken brick jelly of 25mm down grade to be laid in the toilet fillings of first floor sunken slab.

**14.17 Bore Well**

The location of bore well will be selected as per ground water survey. The location so selected has to serve the purpose of water supply as per design. The sinking of bore well upto the required depth by mechanical arrangements using pressure hose, heavy type hollow drilling rods including chistle headed rotary to penetrate into the rock also. After reaching the required depth, the yield test as per standard practice using V notch, etc. shall be done for minimum 24hrs continuously to find out the quantum of water. Based on the sub soil strata to avoid sliding / collapsing of sub soil in the bore hole, casing of required depth by using PVC / MS slotted pipe with necessary net around the pipe to avoid silt coming in sides may also be used to suit the dia of bore. The water so obtained after the yield test shall also be tested in the laboratory for the suitability of drinking purpose.

Sinking bore well shall be upto required depth by mechanical arrangements including casing pipe to the depth directed by Engineer. The bore well cap shall also be provided. In order to have the bore well at the appropriate locations for getting water, geological survey shall also be done in the initial stage.

# SPECIFICATION

# FOR

# STORM WATER DRAINAGE

**15.0 Storm Water Drainage**

The specifications for materials and workmanship of the individual items of work shall conform to the corresponding specifications in the earlier sections.

The work shall be carried out in accordance with the rules and regulations of the local Drainage Authority. Necessary provisions for sight rails, boning stakes, etc. shall be made.

Tests regarding water tightness of joints and cleanliness of pipes shall be performed before the trenches are covered.

Work of laying pipelines and providing manholes, chambers, etc. shall include necessary excavation in any strata including old foundations of any description excluding hard rock, refilling the trenches in layers of 15cm, watering and consolidation.

**15.1 Pipes**

All hume pipes (reinforced) shall conform to the relevant IS and shall be new, perfectly sound, free from cracks, cylindrical, straight and of specified nominal diameter. They shall be made of reinforced cement concrete manufactured by centrifugal or spun process and shall be of even texture.

**15.2 Trenches**

The trenches for laying shall be excavated to lines and levels as directed. The bed of the trench shall be truly and evenly dressed throughout, from one change of grade to the next.

The gradient shall be set out by means of boning rods and the required depth shall be exceeded at any point, the trench shall be brought to proper grade by means of cement concrete of the specification for the bed concrete or lime concrete without any extra cost.

The bed of the trench, if in soft or made up earth, shall be well watered and rammed and depressions thus formed filled with sand or other suitable materials as directed by the Engineer.

If rock is met with, it shall be removed to 15cm below the level of the pipe and the trench will be refilled with bed concrete, sand or suitable material approved by the Engineer.

The trench shall be kept free from water. Shoring and timbering shall be provided wherever required, as part of the trench work.

The width of the trench shall be the nominal diameter of the pipe plus 38cm but not less than 52cm.

**15.3 Laying of Pipes**

No concreting is usually required. In case, where the soil is made up or is very soft, concreting may be resorted to form the bed of the trench below the pipe, if directed by the Engineer at no extra cost, unless otherwise provided for in the schedule of quantities.

The pipes shall be carefully laid to levels and gradients shown in the plans and sections. Great care shall be taken to prevent sand, etc. and other extraneous substances / material from entering the pipes. The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipe shall for its entire length rest on an even bed in the trench with excavation to bed the collar for the purpose of jointing.

**15.4 Jointing**

A few skeins of spun yarn soaked in neat cement wash shall be inserted in the groove at the end of the pipe and the two adjoining pipes butted against each other. The collar shall then be slipped over the joint, covering equally both the pipes. Spun yarn soaked in neat cement wash shall be passed round the pipes and inserted into the joint by means of caulking tools from both ends of the collar. More skeins of yarn shall be added and well rammed in.

The object of the yarn is to center the two ends of the pipes within the collar and to prevent jointing mortar penetrating into the pipes.

Cement mortar with one part of cement and one part of sand, slightly moistened (but must on no account be soft or sloppy) shall carefully be inserted by hand into the joint and more cement mortar added and caulked in until the entire space of the joint has been filled completely and tightly. The joint shall be finished off neatly outside the collar on both sides to camber at an angle of $45^0$.

Any surplus mortar projecting inside the joint shall be removed and to guard against any such projections sack or gunny bag shall be drawn past each after completion.

Cement mortar joints shall be cured at least for seven days.

**15.5 Testing**

All joints shall be tested to a head of 60cm of water above the top of the highest pipe between two manholes. The lowest end of the pipe shall be plugged watertight. Water shall then be filled in the manhole at the upper end of the line. The depth of water in the manhole shall be 60cm plus the diameter of the pipe. The joint shall then be examined. Any joint found to be leaking or sweating shall be remade and embedded into 15cm layer of cement concrete (1:2:4) 30cm in length and the joint rested without any extra cost.

**15.6 Manhole**

Sizes of manholes shall be as specified in the item and they shall be of internal sizes. The work shall be done strictly as per standard drawings and specifications.

**15.7 Bed Concrete**

Shall be in 1:4:8 cement concrete 23cm (9") thick unless otherwise provided for.

**15.8 Brick Work**

Shall be with best quality well burnt local bricks and proportion of cement mortar shall be 1:4 unless otherwise specified.

**15.9 Plaster**

Inside of the walls shall be plastered with 12mm thick cement plaster 1:3 and finished with a floating coat of neat cement. The external face shall be pointed with 1:3 cement mortar unless otherwise provided for.

**15.10 Benching**

Channels and benching shall be done in cement concrete 1:2:4 rendered smooth with neat cement.

**15.11 Foot Rests**

M.S. square bars of 22mm (7/8") diameter or C.I. rungs shall be embedded in masonry where depth of manhole exceeds 1m and they shall be 35cm apart, projecting 11cm from the wall. Footrests shall be painted with bitumen as directed.

**15.12 Manhole Covers**

Covers for manholes in the road shall weigh not less than 200kg. On footpaths and in backyards, lightweight covers for 45cm dia shall weigh not less than 58 kg. For 90cm X 45cm or 61cm X 45cm sizes of covers shall be 90 kg. in weight.

**15.13 Drop Connection**

In the case of a drop connection, C.I. pipes shall be provided with heel rest bend at the bottom and bend with access door at the top for cleaning purposes. The pipes shall be encased in 1:3:6 plain cement concrete.

# SPECIFICATION FOR SANITARY PLUMBING SEWERAGE AND WATER SUPPLY WORKS

**6.1 Scope of Work**

The contract shall generally include the following services.

i. Installation of sanitary ware, fixtures and faucets and toiletries.
ii. Installation of soil, waste and vent and rain water pipe work.
iii. Installation of internal hot and cold water supply distribution network.
iv. Installation of overhead water storage tanks including making connections with the pipe work and construction of tank supporting structure.
v. Laying of underground drainage system including construction of manholes, gully chambers and all other related appurtenances upto building manholes.

The tenderer shall include for the supply, delivery, installation, connection, commissioning and testing of all the materials and equipment to provide a complete sanitary plumbing, sewerage, water supply installation as described hereunder:

**16.2 General**

**16.2.1 Statutory Regulations and Approvals**

All sanitary and water supply works shall be carried out only by those Tenderers who are licensed by the concerned local authorities to execute this type of work.

It shall be the responsibility of the Tenderer to comply with the regulations as laid down by the local authorities. The Tenderer shall also be responsible for obtaining all the statutory approvals / certificates (Form C & D, etc.) for the work from the concerned local authorities, including necessary laisoning with concerned local authorities at his own cost and these certificates shall be handed over to the Engineer at the completion of the contract.

It shall also be the responsibility of the Tenderer to get the sewerage and water supply connections from the concerned authorities. However, the Employer shall bear all the statutory expenditures.

**16.2.2 Site Conditions**

It is assumed that before tendering, the Tenderer would have visited the site and familiarised himself with all local conditions and means of transportation and

communications. No claim, of whatsoever nature, shall be entertained at a later date on account of the Tenderer's ignorance of the local conditions.

**16.2.3 Standard and Codes of Practice**

The work shall be carried out as per the enclosed specifications of work and the construction drawings to be issued from time to time. These specifications shall be read in conjunction with National Building Code – 1983, relevant codes of practice and standards as issued by ISI (all with the latest amendments).
Latest editions shall always be consulted.

| | |
|---|---|
| IS : 458 | Precast Concrete Pipes (with & without reinforcement). |
| IS : 651 | Salt Glazed Stoneware Pipes and Fittings. |
| IS : 771 | Glazed Fire Clay Sanitary Appliances. |
| IS : 772 | General Requirements for Enameled Cast Iron Sanitary Appliances. |
| IS : 774 | Flushing |
| IS : 775 | Cast Iron Brackets and Supports for Wash Basins and Sinks. |
| IS : 778 | Copper Alloy Gate, Globe and Check for water works purpose. |
| IS : 780 | Sluice Valves for water works purposes. |
| IS : 781 | Cast Copper Alloy Screw down Bin Taps and Stop Valves for water services. |
| IS : 782 | Caulking Lead. |
| IS : 783 | Code of Practice for Laying of Concrete Pipes. |
| IS : 784 | Pre stressed Concrete Pipes. |
| IS : 1171 | Ferromanganese |
| IS : 1172 | Code of Basic Requirements for Water Supply Drainage and Sanitation. |
| IS : 1200 | Methods of Measurement of Building and Civil Engineer – in – Charge of works. |
| IS : 1230 | Cast Iron Rainwater Pipes and Fittings. |
| IS : 1239 | Mild Steel Tubes and Mild Steel Tubular and other Wrought Steel Pipe Fittings. |
| IS : 1536 | Centrifugally Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage. |
| IS : 1537 | Vertically Cast Iron Pressure Pipe for Water, Gas and sewage. |
| IS : 1538 | Cast Iron Fittings for Pressure Pipe for Water, Gas and Sewage. |
| IS : 1626 | Asbestos Cement Building Pipes, Gutters and Fittings (spigot and socket types). |
| IS : 1703 | Copper Alloy Float Valves for Water Supply Fittings. |
| IS : 1726 | Cast Iron Manhole Covers and Frames intended for Use in Drainage Works. |
| IS : 1729 | Sand Cast Iron Spigot and Socket Soil Waste and Ventilating Pipes, Fittings and Accessories. |
| IS : 1742 | Code of Practice for Building Drainage. |
| IS : 1916 | Steel Cylinder Pipe with Concrete Lining and Coating |
| IS : 2064 | Code of Practice for Selection, Installation and Maintenance of Sanitary Appliances. |
| IS : 2065 | Code of Practice for Water Supply in Building. |
| IS : 2470 | Code of Practice for Installation for Septic Tank. |
| IS : 2527 | Code of Practice for Fixing Rain Water Gutters and Down Pipes for Roof drainage. |
| IS : 2548 | Plastic Seats and Covers for Water Closet. |
| IS : 3076 | Low Density Polyethylene Pipes for Potable Water Supplies. |
| IS : 3114 | Code of Practice for Laying of CI Pipes. |
| IS : 3486 | Cast Iron Spigot and Socket Drain Pipes. |
| IS : 3589 | Seamless or Electrically Welded Steel Pipe for Water, Gas and Sewage. |

| | |
|---|---|
| IS : 3989 | Centrifugally Cast (Spun) Iron Spigot and Socket Soil Waste and Ventilating pipe, Fittings and Accessories. |
| IS : 4111 | Code of Practice for Ancilliary Structures in Sewerage System. |
| IS : 4127 | Code of Practice for Laying of Glazed Stoneware Pipes. |
| IS : 4984 | Specification for High Density Polyethylene Pipes for Potable Water Supplies, Sewage and Industrial Effluents. |
| IS : 5219 (Part – I) | Cast Copper Alloy Traps. |
| IS : 5329 | Code of Practice for Sanitary Pipe Work Above Ground for Buildings. |
| IS : 5961 | Specification for Cast Iron Gratings for Drainage Purposes. |

**16.2.4 Workmanship:**

All the work shall be carried out in a workmanship like manner as per the best practices of the trade.

**16.2.5 Material Statements, Samples and Shop Drawings**

After the award of the contract, the Tenderer shall make and submit a statement (in duplicate) mentioning the make and the quality of the materials and equipment he proposes to supply. The statement shall be supported by the relevant catalogues / literature of the manufacturers. It shall also be the responsibility of the Tenderer to submit without any extra charge the sample as of material / equipment as and when asked by the Engineer. The sample shall be submitted to the Engineer within thirty days of the award of the contract. The Tenderer shall use only those materials / equipment for which the approval from the AEC & PMC has been obtained. If the Tenderer wishes to use an alternative make due to non – availability of the approved one, he should take the prior approval of the Employer. Under such situations, the Tenderer shall show such promptness as not to hamper the progress of the work.

The Tenderer shall submit for AEC approval, the shop drawing of all the custom – built equipment, including fire fighting system and pumping system, he proposes to install.

**16.2.6 Work and Time Schedule**

The Tenderer shall prepare a work and time schedule in a format approved by the Engineer. The schedule shall be submitted to the Engineer within thirty days of the award of the contract. It shall indicate the expected date of commencement and completion of each item of work. The chart shall also indicate the scheduling of samples, shop drawings and approvals. In addition to this, the Tenderer shall also furnish to the Engineer fortnightly progress reports indicating percentage completion of each item of work.

**16.2.7 Plumbing Drawings**

The plumbing drawings issued from time to time to the Tenderer are diagrammatic but shall be followed as closely as actual construction and work will permit. Any deviation from the drawings required to conform to the building construction shall be made by the Tenderer at his own expenses. The architectural drawings shall take precedence over the services drawings as far as the civil and other trade works are concerned.

**16.2.8 Discrepancies in the Drawings**

If there is any discrepancy due to incomplete description, ambiguity or omission in the drawings and other documents relating to this Contract found by the Tenderer either before starting the work or during execution or after completion, the same shall be immediately brought to the attention of the Engineer and his decision would be final and binding on the Tenderer.

**16.2.9 Materials**

All materials to be supplied by the Tenderer shall be new and as per relevant IS code. All packed items shall arrive at site in original packing only. Any items found defective or damaged shall be replaced by the Tenderer at his own expense.

**16.2.10 Storage of Materials**

All the materials brought to the site shall be stored and stacked in a proper manner. The materials requiring protection from the sun and rain shall be kept inside the temporary structures to be erected at site by the Tenderer. The Tenderer shall also follow the manufacturer's instructions for storage and stacking the materials.
The storage facilities shall be created by the Tenderer at his own expense.

**16.2.11 Instruments for Measurement and Testing**

The Tenderer shall provide, free of cost, all equipment, instruments, labour and all other allied assistance by the Engineer or his representatives for measurement and testing of the works.

**16.2.12 Coordination with Other Trades**

The Tenderer shall be responsible for coordinating this work with works of other trades sufficiently ahead of time to avoid unnecessary hold ups. Hangers, sleeves, recesses, etc. shall be left in time as the work proceeds.

**16.2.13 Site Dairy**

The Tenderer shall maintain a Site Dairy, in which daily progress of the work and number of workers engaged shall be recorded. The site dairy shall also be used by the Engineer for writing his comments / instructions.

**16.2.14 Upkeep of the Site**

It shall be the responsibility of the Tenderer to clear away, from time to time, all debris and excess material generated by the activities of his workers.

**16.2.15 Protection**

All work shall be adequately protected, to the satisfaction of the Engineer so that the whole work is free from the damage throughout the period of construction up to the time of handing over.
Special care must be taken to prevent damage and scratching of all fittings and fixtures. Tool marks on exposed fixtures shall not be accepted. Protective paper on fixtures shall be removed with hot water only at the final completion of the work.
Before handing over the work, the Tenderer shall clean all elements of the complete installation, remove plasters, splashes, stickers, rust, stains and all other foreign matter and leave every part in acceptable condition and ready for use to the satisfaction of the Engineer.

**16.3 Sewerage**

**16.3.1 Excavation, Alignment and Grading**

The sewers shall be laid to alignment and gradients shown on the drawings but subject to such modifications as shall be ordered by the Engineer from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction of the Engineer.

**16.3.2 Excavation in Tunnels**

The excavation for sewers and works shall be open cutting unless the permission of the Engineer for the ground to be tunneled is obtained. Where sewers have to be constructed

along narrow passages, the Engineer may order the excavation to be made partly in open cut and partly in tunnel and in such cases the excavated soil shall be removed at once, so that not to block up the passage and shall be brought back later on for refilling of the trenches or tunnels.

**16.3.3 Opening out Trenches**

In excavating trenches, etc. the soling, road metalling, pavement, kerbing and turf, etc. shall be placed on one side and preserved for reinstatement after filling back the trenches.

Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Engineer and of the owners of the roads or the property transversed and the Tenderer shall not cut or break any live fence or trees in the line of the proposed works but shall tunnel under them, unless the Engineer shall order to the contrary.

The Tenderer shall group up and clear the surface over the trenches and other excavation of all trees, stumps, roots and all other encumbrances affecting execution of the work and shall remove them from the site as approved by the Engineer.

**16.3.4 Obstruction of Roads**

The Tenderer shall not occupy or obstruct by his operation more than one half of the width of any road or street, and if insufficient space is left for public and private transit he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Tenderer shall obtain the consent of the Engineer before closing any roads to vehicular traffic. The footpaths shall be kept clear at all times.

**16.3.5 Removal of Filth**

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cesspool, shall not be deposited upon the surface or any street or where it is likely to be nuisance or passed into any sewer or drain but shall be at once put into carts and removed to a suitable place to be provided by the Tenderer.

**16.3.6 Excavation to be taken to Proper Details**

The trenches shall be excavated to such a depth that the sewers shall rest on concrete as per specifications and drawings so that the inverts may be at the levels given on the sections. In bad ground, the Engineer may order the Tenderer to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewer with concrete, broken stone gravel or other materials. Any such extra excavation, if ordered by the Engineer, shall be extra as per provisions in the Contract Conditions, but if the Tenderer excavates the trench to a greater depth than is required as per drawings without a specific order to that effect of the Engineer, the extra depth shall have to be filled up with concrete at the Tenderer's own costs to the satisfaction of the Engineer.

**16.3.7 Refilling**

After the sewer or other work has been laid and proved to be water tight the trench or other excavations shall be refilled. Utmost care shall be taken in doing this so that no damage shall be caused to the sewer and other permanent work. The filling in the trenches and upto 75 cm above the crown of the sewer shall consist of the finest selected materials placed carefully in 15cm layers and flooded and consolidated. After this has been laid, the trench and the other excavation shall be filled carefully in 150mm layers with materials taken from the excavation each layer being watered for proper consolidation unless the Engineer shall otherwise direct.

**16.3.8 Tenderer to Restore Settlements and Damages**

The Tenderer shall, at his own expense, make good promptly during the whole period of he works are in hand, any settlements that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces, etc. whether public or private, caused by his trenches or his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expense, repair and make good any damage done to buildings and other property. If in the opinion of the Engineer, the Tenderer fails to make good such work / property, the Engineer shall be at liberty to get the work done by other means and the expenses thereof shall be paid by the Tenderer or deducted from any money that may be or become due to him or recovered from him in any other manner according to the conditions of the contract.

**16.3.9 Disposal of Surplus Soil**

The Tenderer shall at his own expense, provide places for disposal of all surplus materials not required to be used on the works. As soon as each trench is refilled, the surplus soil shall be immediately removed, the surface properly dressed and restored and roadways and sides left clear.

**16.3.10 Timbering of Sewer Trenches**

The Tenderer shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be close timbered in loose or sandy strata and below the surface of the subsoil water level, without any extra cost.

All timbering, sheeting and piling with their wallings and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place. The Tenderer shall be held responsible and accountable for the sufficiency of all timbering, bracing, sheeting and piling used for, all damage to persons and property resulting from the improper quality, strength, placing and maintaining or removing of the same.

**16.3.11 Shoring of Buildings**

The Tenderer shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all the damages to persons or property resulting from any accident to any of such buildings.

**16.3.12 Removal of Water from Sewer**

The Tenderer shall at all times, during the progress of work, keep the trenches and excavations free from water which shall be disposed off by him in a manner as will neither cause injury to the public health nor to the public or private property not to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of them same by the public.

**16.3.13 Excess Excavation**

If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope the same shall be filed with concrete by the Tenderer at is own expense to the satisfaction of the Engineer.

**16.3.14 Width of Trenches**

Unless specified otherwise by the Engineer, the width at bottom of trenches for pipes of different diameters laid at different depths shall be as given below:

(a) For all diameters, up to an average depth 120cm, width of trench in cm = diameter of pipe + 30cm.

(b) For all diameters for depth above 120cm, width of trench in cm = diameter of pipe + 40cm and
(c) Notwithstanding (a) and (b), the total width of trench at the top should not be less than 75cm, for depths exceeding 90 cm.

## 16.4 Reinforced Cement Concrete Pipes

### 16.4.1 Specifications

Wherever specified for sewerage, the RCC pipes shall be centrifugally spun type conforming to IS: 498 – 1988 with latest amendments. The pipe shall be straight with uniform bore throughout. Cracked or warped pipe shall not be allowed to be used.

### 16.4.2 Laying

All pipes shall be laid on a bed of 15cm thick cement concrete 1:5:10 mix or as specified, projecting on each side of the pipe to the full width of the trench. The pipes with their crown level at 1.2m depth and less from ground shall be covered with 15cm thick cement concrete 1:5:10 mix above the crown of the pipe and sloped off to meet the outer of the base concrete to give a minimum thickness of 15cm around the pipe. Pipes laid at a depth greater than 1.2m at crown shall be concreted at the sides up to the level of the center of the pipe tangentially.

Pipes shall be laid true to line and grade as specified. Laying of pipe shall proceed upgrade of a slope.

### 16.4.3 Jointing

Joints shall be of the rigid type.

**a. Spigot and Socket Joint**

The spigot of each pipe shall be slipped well into the socket of the pipe previously laid and adjusted in the correct position. The joint shall then be made with a stiff mixture of cement mortar 1:2 mix (1 cement: 2 fine sand), which shall be properly caulked. The spigots and sockets shall be thoroughly wet before the joints are made.

**b. Collar Joint**

The two adjoining pipes shall be butted against each other and correctly adjusted. The collar shall then be slipped over the joint so as to cover both the pipes equally. The space around the joint shall be filled with a stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) and properly caulked.

## 16.5 Salt Glazed Stoneware Pipes

### 16.5.1 Specifications

Wherever specified for drainage / sewer lines, salt glazed stoneware pipes shall be used. These pipes shall be of first quality, straight, free from any roughness inside or outside and conforming to IS : 651 – 1980 with latest amendments.

### 16.5.2 Laying

The pipes shall be laid on a bed of 150mm thick cement concrete 1:5:10 mix or as specified, with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipes jointer room to work right round the pipes and as short as practicable to admit the socket and allow the joint to be made.

If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on concrete cradles to ensure even bearing.

The pipes with their crown level at 1.2m depth and less from finished ground level shall be surrounded with 15cm thick cement concrete 1:5:10 mix all around pipes laid at a depth greater than 1.2m at crown shall be concreted at the sides up to the level of the center of the pipe and slopped up from the edges to meet the pipe tangentially.

Tarred gasket of hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot then shall be slipped well into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked home so as to fill not more than $1/4^{th}$ of the total depth of the socket.

The remaining depth of the socket shall then be filled with a stiff mixture of cement mortar 1:1 (1 cement: 1 fine sand). When the socket is thus filled, a fillet shall be formed round the joint with a trowel forming an angle of $45^0$ with the barrel of the pipe.

### 16.6 Cast Iron Pipes

#### 16.6.1 Specifications

Wherever specified, the cast pipes for drainage shall be either centrifugally cast spun pipes conforming to IS: 3989 – 1984 or sand cast type conforming to IS: 1729 – 1979 with latest amendments. Generally all drainage lines passing under the buildings, floors, roads with heavy traffic and in exposed position above ground or like situations shall be in cast iron.

#### 16.6.2 Laying and Jointing

All excavation work for laying cast iron drainage pipes shall be done as described before. Jointing shall be done as described below.

All drainage lines passing under buildings, floors and roads, in exposed horizontal positions above ground, shall be cast iron pipes. Pipes shall be sand cast conforming to Class 'A' IS: 1537 or centrifugal spun cast iron pipes Class LA conforming to IS: 1536.

These shall be free from cracks and other flaws. The interior of pipes and fittings shall be clean and smooth and painted inside and outside with Dr. Angus Smith's solution or other approved anti corrosive paint.

The access door fittings shall be of proper design so as not to form any cavities in which filth may accumulate. Doors shall be provided with 3mm (1/8") rubber insertion packing and when closed and bolted they shall be watertight.

### 16.7 PVC pipes

#### 16.7.1 Rigid PVC Pipes

Wherever specified, the rigid PVC pipes for underground drainage, cold water services both external and internal soil waste piping system shall conform to IS: 4985 revised in all respects. Fittings used shall be of the same make as that of PVC pipes. Joints wherever required shall be made by solvent welding.

#### 16.7.2 UPVC Pipes

14.6.3 UV stabilized UPVC main water pipes shall conform to IS: 13592 – 1992 Type A with minimum thickness of 1.8 mm & Rubber Ring shall conform to IS: 5382.

Fittings for UPVC main water pipes viz., Couplers, Tees, Bends, Junction Reducer, etc. shall conform to DIN – 19534 – 1979 or ISO 3663 – 1991 with minimum thickness of 1.8 mm.

14.6.4 UV stabilized UPVC soil & vent pipes shall conform to IS: 13592 – 1992 Type B with minimum thickness of 3.2mm & V shaped rubber ring to IS: 5382.

Fittings for UPVC soil & vent pipes viz., Floor Traps, Bends, Tees, V junction, Reducers, etc. shall conform to DIN – 19534 – 1979 or ISO 3663 – 1991 with minimum thickness of 3.2mm.

### 16.8.0 Soil, Waste and Vent Pipes

### 16.8.1 Cast Iron Pipes and Fittings

#### 16.8.1.1Specifications

Cast iron pipes fittings conforming to IS: 1729 – 1979 (or as revised) shall be used for soil, waste and vent pipes, pipes and fittings with irregular bore, blow holes and other manufacturing defects shall not be allowed to be used for work. All fittings shall be of the degree specified or as required at site.

#### 16.8.1.2Jointing

The spigot of the pipe shall be placed inside the socket and gasket caulked home. The interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right upto the back of the socket and carefully centered by two or three laps of treated spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket to leave the depth for load as specified in the table below. Molten pig lead shall then be poured into the joint filling the same in one pouring. The lead shall be caulked by proper tools to make it even all around. The pig lead shall conform to IS: 782 – 1978 with latest amendments.

The depths of lead required for joints in various sizes of cast iron pipes are

| Nominal Dia (mm) | Depth of Lead (mm) |
|---|---|
| 50 | 25 |
| 75 | 25 |
| 100 | 25 |
| 150 | 38 |

### 16.9 Holder Bat Clamps

All pipes shall be fixed 25mm clear off the wall with MS holder bat clamps. Holder bat clamps shall be of a standard design fabricated from MS galvanised flat 32 X 1.5mm thick and 12mm dia MS bar and 6mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete (1:2:4) blocks 100 X 100 X 100mm.

### 16.9.1 Stays

The terminal vent part of all soil, waste and vent pipes shall be supported with MS stays. The stays shall be minimum 1m long of 10mm dia MS bar. One end of stay shall be bent for embedding in the wall in cement concrete block of size 20 X 10cm in 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size) The concrete shall be finished to match the surrounding surface.

### 16.10 Traps

### 16.10.1 General

The entry of foul air to the building shall be prevented by suitable traps, properly situated. Traps shall always be of a self – cleaning pattern. A trap, which is not an integral part of an appliance, shall be directly attached to its outlet and the pipe bore shall be uniform throughout and have a smooth surface.

Traps for use in domestic waste installations and all other traps shall be conveniently accessible and provided with cleaning eyes or other means of cleaning.

The size of the trap shall be as per the internal diameter of waste pipe of the appliances to which is attached. Minimum internal diameter for various waste appliances are as given in the following table.

| Item | Diameter (mm) |
|---|---|
| Drinking fountains | 25 |
| Wash basins | 30 |
| Domestic sinks and baths | 40 |
| Shower bath trays | 40 |
| Domestic bath tubs | 50 |
| Hotel and canteen sinks | 50 |
| **Urinals** | |
| Stall Urinals (with not more than 1.20m of channel drainage) | 50 |
| Lip Urinals | 40 |
| Floor Traps (outlet diameter) | 65 |

**16.10.2 Floor Traps**

Floor traps shall be cast iron deep seal type P or S traps with a minimum seal of 50mm. They shall be with or without vent. All traps shall be set in cement concrete block 1:2:4 mix without additional cost.

Urinal traps shall be provided with CP brass dowel grating. Traps shall be provided with suitable extension pieces where required, with chromium plated grating to flush with the floor without any extra cost.

**16.11 Installation of Soil, Waste and Ventilation Pipe Work**

**16.11.1 Gradient**

The gradient of a horizontal branch shall not be flatter than 1 in 50 and not steeper than 1 in 10.

**16.11.2 Pipe Work**

The pipe work in branch connections shall always be arranged to allow free drainage of the system. Connections to main or branch pipes shall be so arranged that to prevent cross flow from one appliance to another. Connections shall be made with an easy sweep in the direction of flow.

**16.11.3 Joint**

All joints in pipe work and all pipe work to appliances shall be made in such a manner as to be airtight and water tight and to remain so during use.

**16.11.4 Bends**

Bends shall be of long radius where practicable. In the case of bender in the bottom most pipes, they shall necessarily be of long radius and shall preferably be made of $135^0$ (1/8) bends.

**16.11.5 Access**

Ample provisions shall be made for access to all pipe work and embedding of joints in walls shall be avoided as far as possible. All tee and cross pieces shall be with access doors. Wherever instructed by the Engineer, the bends width access doors shall also be

provided. The bottom most pipe of every soil and waste stack shall be provided with an excess piece of a height not more than 30cm from the finished ground level.

**16.11.6 Soil Pipe**

Soil pipe, whether inside or outside the building, shall not be connected with any rain water pipe and there shall not be any trap in such soil pipe or between it and any drain with which it is connected.

**16.11.7 Ventilating Pipe**

(a) Ventilating pipe shall be so installed that water cannot be retained in them. They shall be fixed vertically. Whenever possible, horizontal runs shall be avoided. Ventilating pipe shall be carried to such a height and in such a position so to afford by means of open end of such pipe or vent shaft, a safe outlet for foul air with the least possible nuisance.

(b) The upper end of the main ventilating pipe may be continued to the open air above roof level as separate pipe or it may joint the MSP and / or MWP above the floor level of the highest appliance. Its lower end may be carried down to join the drain at a point where air relief may always be maintained.

(c) Branch ventilating pipes shall be connected to the top of the BSP and BWP between 75mm and 450mm from the crown of the trap.

(d) The ventilating pipe shall always be taken to a point 150cm above the level of the caves or flat roof or terrace parapet whichever is higher or the top of any window within a horizontal distance of 3cm. The least dimension shall be taken as a minimum and local conditions shall be taken into account. The upper end of every ventilating pipe shall be protected by means of a cowl.

**16.11.8 Concrete Encasing**

All soil and waste pipes below ground floor fills and in walls chases (but not in open ducts) shall be supported and covered with 50mm cement concrete 1:3:6 in bed and all around without any extra cost. Encasement of such pipes shall be done after testing of pipes.

**16.11.9 Painting**

All pipes in ducts and exposed position shall be painted with minimum three coats of paint of approved shade and quality. Pipes under floor or in chases need not be painted.

**16.12 Rain Water Pipe**

UV stabilized UPVC Pipes for the conveyance of rainwater from the roof top, balcony, etc. shall be used. The pipes shall conform to IS: 13592 – 1992 Type A and shall have a minimum thickness of 1.8 mm.

**16.13 Manholes and Inspection Chambers**

The maximum distance between manholes shall be 30m unless specially permitted otherwise. In addition, at every change of alignment / gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise. Manhole shall be constructed so that to be watertight under test. The benching at the sides shall be carried out in such a manner so to provide no lodgement for any splashing in case of accidental flashing of the chamber. The chamber or drain at the bottom of chamber shall be plastered with 1:3 cement, sand mortar and finished smooth to the grade. The channels and rains shall be shaped and laid to provide smooth flow. Connection to existing sewer lines shall be through a manhole. Manholes shall be provided with standard cover, usually C.I. or as desired by the Engineer. The covers shall be close fitting so that to prevent gases come out.

**16.13.1 Size of Manholes**

The size specified in the Schedule of Quantities shall be internal size of the manhole. The work shall be done strictly as per standard drawing and following specifications.

**16.13.2 Bed Concrete**

Shall be in 1: 4: 8 cement concrete 150 mm thick for inspection chambers, 230 mm for depths upto 2.1 metres and 300 mm for greater depths in case of manhole.

**16.13.3 Brick Work**

Shall be with locally available best quality chamber burnt bricks in 1: 4 cement mortar or as specified.

**16.13.4 Concrete Manhole**

RCC manholes shall be with M20 grade concrete or as specified and as per drawing. Specifications for concrete works and steel reinforcement shall be followed.

**16.13.5 Plaster**

Inside of the walls shall be plastered with 12 mm thick cement plaster 1:3 and finished with a floating coat of neat cement. In wet grounds, 20 mm thick plaster of the above specification shall be done on the exterior surface of the walls also and this plaster shall be waterproofed with the addition of approved water proofing compound as per manufacturer's specification.

**16.13.6 Pointing**

In dry ground, pointing shall be done in 1:2 cement mortar to the outside surface.

**16.13.6 Benching**

Channels and benching shall be done in cement concrete 1:2:4 rendered smooth with neat cement. The following size of channels for the bench shall be adopted.

| Size of Drain | | Depth at Centre | | Depth at Sides of Walls | |
|---|---|---|---|---|---|
| In cm. | In inch | In cm. | In inch | In cm. | In inch |
| 10 | 4 | 15 | 6 | 25 | 10 |
| 15 | 6 | 20 | 8 | 30 | 12 |
| 23 | 9 | 28 | 11 | 38 | 15 |
| 30 | 12 | 35 | 14 | 45 | 18 |
| 38 | 15 | 43 | 17 | 53 | 21 |
| 45 | 18 | 50 | 20 | 61 | 24 |

**16.13.7 Foot Rests**

C.I. foot rests / steps shall be embedded in masonry, whenever the depth of the manhole / chamber is more than 1.2m as shown in the drawing. They shall be fixed 30cm. apart and projecting 11cm. from the wall. Foot rests shall be painted with bitumen as directed.

**16.13.8 Manhole Covers**

Manhole covers shall be of tough homogeneous cast iron of heavy or light type as specified. The sizes specified are the clear internal dimensions. Covers for manholes in the road proper shall not weigh less than 200kg. On footpaths and backyards, light weight covers of 45cm. diameter having weight not less than 58kg. or covers of size 90cm. X 45cm. having weight of 135kg. or 61cm. X 45 cm. having weight of 90kg. shall be used.
Covers shall be of heavy duty cast iron with lifting hooks as per the details given in the drawing and fixed on the CI frame embedded in concrete. Cover placed on the frame shall be airtight. Weight of the cover and frame shall be as specified in the schedule of quantities.

The frame and the cover shall be painted with black bitumen anti corrosive paint.

**16.13.9 Drop Connection**

In case of drop connection, CI pipes shall be provided with heel rest bend at the bottom and bend with access door at the top for cleaning purposes.

**16.14 Sanitary Installation & Fixtures**

All fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to the site shall bear identification mark of the type and manufacturer. Procurements shall be made well in advance and got inspected and approved immediately by the Engineer. All fixtures shall be adequately protected covering and plugging till handed over. All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. All fixtures shall be fixed in a neat workman like manner true to line and as recommended by the manufacturer or shown on the drawings. Care shall be taken to fix all fixtures, brackets and accessories by proper wooden cleats, rawl plugs, bolts and nuts as each fixture will warrant with the correct site of screws, nuts or bolts. Care shall be taken in fixing all approved chromium plated fixtures and accessories so that not to leave any tool marks or damages. All such fixtures shall be tightened with fixed spanners. Use of pipe wrenches with toothed jaws shall not be allowed. All fixtures shall be thoroughly tested after connecting up the drainage and water supply system. All fixtures shall be thoroughly finished and any leakage in piping, valves and waste fittings corrected to the entire satisfaction of the Engineer. Upon completion of the work, remove all labels, stickers, plasters, etc. from the fixtures and clean all fixtures with soap and water so that to present a neat and clean toilet.

**16.15 Water Closet**

**16.15.1Indian Type W.C. Pans**

The W.C. pan shall be of white vitreous china, of specified size and pattern. Pan shall be of approved quality and shall bear the mark of the firm manufacturing it. It shall have 10cm (4") porcelain trap ('P' or 'S' type with effective seal) and 5 cm (2") vent arm. The footrests shall be of white glazed stoneware with chequered surface.

**16.15.2 Orissa Type Pans**

Shall be from an approved manufacturer and trapped as specified above.

**16.15.3 Fixing**

Pan shall be fixed securely with a cushioning bed in an approved manner taking care that the cushion is uniform and even, without having any hollows between pan and the concrete. The joint between the pan and the trap shall be made with cement mortar 1: 1 and shall be leak proof. Each closet shall be provided with the following accessories and the rate shall be all inclusive.

- Necessary length of 10cm. H.C.I. pipe or lead pipe connecting the pan and plug bend.(The plug bend / tee connection to vertical stack shall be paid under appropriate item).
- Wherever anti siphonage pipe connections are required necessary length of lead pipe 62.5 mm. dia. shall be provided.
- Necessary length of porcelain or lead or C.I. connecting pipe 10cm. dia (plug bend / tee connection to vertical stack shall be paid under appropriate item.).

**16.15.4 Painting**

All fittings and fixtures shall be painted with two coats of enamel paint over a coat of primer.

**16.15.5 European Type W.C.**

The closet shall be of white vitreous china readily flushed, of "wash down type" and shall be of best quality manufactured by an approved firm, and fixed to the floor by approved means. It shall have 100 mm dia. porcelain 'P' or 'S' trap with effective seal. Each closet shall be provided with the following accessories and the rate shall be all inclusive.

**16.15.6 Seat**

Heavy black plastic seat of approved quality and seat cover with rubber buffers fixed to the pan with C.P. brass bar hinge.

**16.15.7 Cistern**

Low level flushing tank 15 litres capacity (3 gal.) of white vitreous china cistern of best quality manufactured by an approved firm with C.P. flush handle and C.P. overflow pipe of length as per Municipal requirement or as per the Engineer's drawing with mosquito – proof bronze cap, etc. complete unit including enameled or C.P flush pipe and bend. Necessary length of lead water inlet pipe and 12mm dia. C.P. brass stopcock. Necessary length of porcelain or lead or C.I. connecting pipe 10cm. dia (Plug bend / tee connection to vertical stack shall be paid under appropriate item). Wherever anti siphonage pipe connections are required, necessary length of lead pipe 6.25cm. dia. shall be provided.

**16.15.8 Painting**

All fittings and fixtures shall be painted with two coats of enamel paint over a coat of primer.

**16.16 Urinals**

**16.16.1 Lipped Urinals**

Shall be flat back or angle urinal of specified dimensions and shall be of white vitreous china from an approved manufacturer. They shall be screwed to the wall with coach screws of chromium plated brass on dowel shaped wooden plugs built into the walls or fixed as per manufacturer's specification. Each basin shall have an outlet with C.P. brass hinged grating connected to 40 mm diameter waste pipe through a C.P. bottle trap. When a range of urinals are provided only a straight length of 40 mm diameter waste pipe and white glazed half round channel with tread platform finished with white glazed tiles complete as per Engineer drawings shall be provided. All joints shall be in plumbers wiped solder joint with necessary C.P. brass sockets and thimble, etc.

**16.16.2 Stall Wall Type Urinals**

Shall be white vitreous china of approved design and manufacturer. They shall be fixed to the wall as per manufacturer's specification. Each urinal shall have an outlet with C.P. brass hinged grating connected to 40mm diameter waste pipe through a C.P. brass bottle trap. All joints shall be in plumbers wiped solder joint with necessary C.P. brass sockets and thimble etc.

**16.17 Flushing Cistern**

This shall be automatic flushing cisterns of vitreous china or as specified in the Schedule of Quantities complete with valve less siphon fittings. Cistern shall be supported on brackets of standard pattern and fixed to wooden dowel plugs embedded in the wall with C.P. brass. screws.

**16.17.1 Angle Valve**

The cistern shall be fed with 15mm (1/2") C.P. brass inlet tube angle valve of approved make with necessary length of lead inlet pipe complete with C.P. brass unions unless otherwise specified in the Schedule of Quantities. The main and distribution pipe fittings

and clamps shall be of C.P. bras unless otherwise specified in the Schedule of Quantities. Distribution pipes shall feed the urinals with C.P. brass spreaders of approved make.

**16.17.2 Painting**

All brackets, etc. shall be painted with two coats of enamel paint over a coat of primer.

**16.18 Lavatory Basin**

**16.18.1 Washbasin**

They shall be of white vitreous china of best quality manufactured by an approved firm and size as specified in the Schedule of Quantities. They shall be supported on a pair of C.I. brackets of approved design.

- **Fittings**
  Each wash basin shall be provided with a single cold water C.P. brass pillar tap of approved design and make, CP brass waste, C.P. brass chain and rubber plug, C.P. brass bottle trap of approved quality and design, with C.P. brass stop cock and water inlet pipe of standard length complete.

- **Waste pipe**
  Waste pipe beyond bottle trap shall be measured and paid separately under appropriate item.

- **Painting**
  All brackets, pipes, etc. shall be painted with two coats of enamel paint over a coat of primer.

- **Sinks**
  They shall be of white vitreous china of best quality and sizes as per the schedule of quantities. They shall be supported on necessary brackets.

- **Fittings**
  Each sink shall be provided with 40mm (1.5") C.P. brass waste of approved pattern with C.P. brass chain and 40mm. Rubber plug and 40mm dia C.P. brass trap and union, which shall be connected to 40mm diameter waste pipe. Waste pipe beyond the trap shall be measured separately and paid under appropriate item. Where specified, sinks shall be provided with puff pipe with a brass perforated screw cap.

- **Painting**
  All fittings, brackets and pipes shall be painted with two coats of enamel paint over a coat of primer.
- **Drain Board**
  Drain board of type and size as specified in the schedule of quantities shall be provided. These shall be fixed on strong brackets of approved design and where necessary provided with hinges. Brackets shall be painted with two coats of enamel paint over a coat of primer.

**16.19 Toilet Requisites**

**16.19.1 Mirrors**

Mirrors shall be of the best quality, specified size, approved design and make. It shall be mounted on asbestos sheet backing and shall be fixed in position by means of four C.P. brass screws and cup washers over rubber washers on wooden plugs firmly embedded in

the wall. Alternative method for fixing could be by using brass clamps with C.P. brass screws. A suitable T.W. cover of approved design shall be fixed all round as directed.

**16.19.2 Glass Shelf**

The shelf shall be made of glass of approved quality and thickness with edges rounded off. The size of the shelf shall be as specified and shall rest on C.P. brass brackets, which shall be fixed with C.P. brass screws to wooden plugs, firmly embedded in the wall. The shelf shall have C.P. brass guard rail all round.

**16.19.3 Towel Rail**

Towel rail shall be of C.P. brass with two C.P. brass brackets. The size of the rail shall be as specified. The bracket shall be fixed by means of C.P. brass screws to wooden cleats firmly embedded in the wall. Where specified, anodised aluminium towel rails may be used of approved quality and design.

**16.9.4 Toilet Paper Holder**

Toilet paper holder shall be of white vitreous china or as specified. It shall be recessed in wall.

**16.9.5 Floor Traps**

The trap shall be of CI and self cleaning and deep water seal type with a 50mm water seal. It shall have a 100mm dia grating. These shall be fixed in concrete to the required level and position.

**16.9.6 Shower**

This shall be of CP finish swivel type as specified.

**16.9.7 Tower Ring, Soap Tray, Cloth Stand, etc.**

These shall be of CP / anodised aluminium as described in the schedule and as per the displayed sample. These shall be fixed by means of CP brass screws to wooden cleats, firmly embedded in the wall.

**16.9.8 Liquid Soap Dispenser**

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

**16.10 Water Heaters**

These shall be of Venus / Racold make. The type and capacity will be as per schedule of quantities. They shall be mounted on the wall with necessary bolts of approved make. They shall have 8mm PVC inlet pipe, 12mm lead pipe outlet, 15mm non return valve.

**16.11 C.I. Soil, Waste and Vent Pipes and Fittings**

**16.11.1 C.I. Pipes and Fittings**

Cast iron soil, waste and vent pipes and fittings shall be of heavy quality conforming to IS: 989 for spun pipes, which are preferred to sand cast soil pipes conforming to IS : 1729. The standard weights and thickness of pipes shall conform to IS: 3989 – 1967 (for Centrifugal Spun Soil Pipe) and IS: 1729 – 1964 (for Sand Cast Soil Pipes) and a tolerance upto 4% may however be allowed against these standards.

**16.11.2 Laying**

The pipes shall be laid as described in the Schedule of Quantities and as shown on the Engineer's drawings.

**16.11.3 Fixing**

The pipes and fittings shall be fixed to walls by using proper holder bat clamps, if directed. The pipes shall be fixed perfectly vertical or in approved alignment. The spigot end shall be the shoulder of the socket and shall leave no annular space in between. All soil and waste water pipes shall be carried up above the roof parapet wall and shall have C.I. vent cowl.

Connections between main pipe and the branch pipes shall be made by using appropriate branches and bends invariably with access doors for cleaning.

**16.11.4 Lead Caulked Joints**

Cast iron pipes shall be laid and joined in conformity with the code of practice for laying of cast iron pipes. Cast iron pipes shall be joined by best quality caulking lead free from all impurities. In wet trenches, joints shall be made with lead wool.

The annular space between the socket and spigot shall be first well packed with spun yarn soaked in bitumen and dried, leaving 25 mm (1") from the lip of the socket for lead for pipes upto 100mm dia and 38mm (1.5") depth for pipes of 150mm dia. The joints may be leaded by using proper leading rings or if they are not available by wrapping a ring of hemp rope covered with clay round the pipe at the end of the socket, leaving a hole through which molten lead shall be poured in.

Molten lead free from zinc or tin and thoroughly fluid shall be poured and each joint filled in one pouring. Before caulking, the projecting lead shall be removed by flat chisels and then the joint caulked round with proper caulking tools and a hammer of 1 to 1.5kg. In weight, in such a manner as to make the joint quite sound. The joint shall be left flush neat and even with the socket.

**16.11.5 Testing**

All C.I. pipes and fittings including joints shall be tested by smoke test as recommended by ISI and left in working order after completion. The acceptance criteria shall be as laid down therein.

**16.11.6 Nahani or Floor Traps**

The traps shall be of self cleaning design deep seal type with a minimum seal of 5cm (2"). If directed, 25 mm puff pipe shall be provided. The other specifications for these shall be the same as those for C.I. soil, waste and vent pipes and fittings. The nahani trap shall be back inlet type.

**16.11.7 Painting**

All exposed C.I. pipes and fittings shall be painted to match the colour of the surroundings with two coats of flat / enamel paint over a coat of approved primer. If directed, additional coats shall be given at no extra cost.

**16.11.8 Lead Pipes**

All lead pipes shall be hydraulic drawn and of equal substance throughout conforming to IS: 404 – 1962. Weights and wall thickness of pipes shall be as under.

| Nominal Diameter | | Wall Thickness | Weight |
|---|---|---|---|
| In mm. | In inch | In mm. | In kg / meter |
| 32 | 1.25 | 2.6 | 3.28 |
| 40 | 1.50 | 2.6 | 3.95 |
| 50 | 2 | 2.7 | 5.07 |
| 75 | 3 | 2.7 | 7.48 |
| 100 | 4 | 2.7 | 9.88 |

When not supported on bearers, all lead pipes shall be supported by strong lead tacks at least 40mm (1.5") wide soldered on to the pipes at suitable intervals.

**16.11.9 Wiped Solder Joints**

All joints of lead pipes shall be wiped solder joints as described here.

The pipe ends to be joined shall be cleaned with a wire brush and free from oxide, if any. Chalk shall then be rubbed to kill the greasy nature of lead. After this, plumber's black shall be applied. The length of the joint as given below shall then be marked on the pipe. A fine shaving of lead shall be removed from this length will shave hook. Tallow shall then be smeared over the prepared surface. The molten solder, an alloy composed of three parts of tin and seven parts of lead, shall be poured in a thin stream from a ladle moved in an elliptical direction over the joint position including a portion of the soil pipe at each end beyond the mark. When sufficient solder has been poured, the joint shall be wiped with pad of wiping cloth with long continuous movements in one direction only so as to leave a neatly formed elliptical shaped joint. Surplus solder remaining on the joint shall be removed.

The length of the wiped solder joint shall be as follows.

| Sl. No. | Size of Pipe | | Length of Joint | | | |
|---|---|---|---|---|---|---|
| | In mm. | In inch | Minimum | | Maximum | |
| | | | In mm. | In inch | In mm. | In inch |
| 1. | 15 | 0.50 | 60 | 2.25 | 70 | 2.75 |
| 2. | 20 | 0.75 | 65 | 2.50 | 70 | 2.75 |
| 3. | 25 | 1.00 | 70 | 2.75 | 75 | 3.00 |
| 4. | 32 | 1.25 | 70 | 2.75 | 80 | 3.25 |
| 5. | 40 | 1.50 | 70 | 2.75 | 80 | 3.25 |
| 6. | 50 | 2.00 | 75 | 3.00 | 90 | 3.50 |
| 7. | 75 | 3.00 | 75 | 3.00 | 90 | 3.50 |
| 8. | 100 | 3.00 | 80 | 3.25 | 90 | 3.50 |

The joints shall be watertight, airtight and shall be free from tears, burrs, strings, ribs and droppings.

**16.11.10 Lead pipe connections**

The joints between lead pipe and C.I. or stoneware pipe shall be made as follows.

One end of brass thimble or ferrule shall be slipped into or over the lead pipe and jointed to it by means of a wiped solder joint. The other end of the ferrule shall then be inserted into the socket of the C.I. or stoneware pipe. In the case of former the joint shall be made with molten lead (lead caulked) and in case of the latter with cement mortar as in stoneware pipe drains.

**The joints between outgo of a WC Pan and a Lead Pipe shall be made as under.**

The Lead Pipe shall be slipped into brass socket and joined to it by a wiped solder joint. The out go of a WC Pan shall then be inserted into the socket and jointed by using cement mortar as in stoneware pipe drains.

**16.11.11 Painting**

All exposed lead pipes shall be painted as in H.C.I. pipes and fittings.

**16.12 Internal Water Services**

**16.12.1 Specifications**

All pipes for water supply (both hot and cold) inside the buildings shall be of genuine PVC threaded pipes conforming to IS: 4985 with latest amendments and commercially available as schedule 40 grade.

All fittings shall be malleable iron galvanised fittings conforming to IS: 1239 (Part II) – 1992 with latest amendments. All fittings shall have manufacturer's trademark stamped on it. Fittings in pipelines shall include elbows, tees, bends, reducers, nipples, union bushes. G.I clamps of approved design of G.I. flanges with 3mm rubber insertion, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's works. Tenderers may be required to produce certificate to this effect from the manufactures.

**16.12.2 Laying and Jointing**

Threaded PVC pipes shall be joined with threaded GI fittings. The sapion tape shall be fixed over the threaded end of pipes before fixing the G.I. fittings. All necessary chasing of walls / floor to be made good after laying the pipes as per the Engineer's instructions.

**16.12.3 Depth of Cover for Underground Water Pipes**

The cover for the mains shall be at least 90cm under vehicular area and 75 cm in pedestrian area.

The details of pipes regarding nominal bore, thickness and weight are given below.

| Approx. kg. Outside dia | Nominal Bore | | Screwed & Socketted Wt. per metre | | | Screwed & Socketted metre per 1000 | | |
|---|---|---|---|---|---|---|---|---|
| In mm. | In mm. | Nearest inch | Light kg. | Medium kg. | Heavy kg. | Light metre | Medium metre | Heavy metre |
| 10.2 | 6 | 0.125 | 0.364 | 0.410 | 0.496 | 2747 | 2439 | 2016 |
| 13.5 | 8 | 0.250 | 0.521 | 0.654 | 0.773 | 1919 | 1529 | 1294 |
| 17.2 | 10 | 0.375 | 0.680 | 0.858 | 1.030 | 1470 | 1166 | 971 |
| 21.3 | 15 | 0.500 | 0.961 | 1.230 | 1.460 | 1040 | 813 | 685 |
| 26.9 | 20 | 0.750 | 1.420 | 1.590 | 1.910 | 704 | 629 | 524 |
| 33.7 | 25 | 1.000 | 2.030 | 2.460 | 2.990 | 493 | 407 | 334 |
| 42.4 | 32 | 1.250 | 2.610 | 3.170 | 3.870 | 383 | 316 | 258 |
| 48.3 | 40 | 1.500 | 3.290 | 3.650 | 4.470 | 304 | 274 | 224 |
| 60.3 | 50 | 2.000 | 4.180 | 5.170 | 6.240 | 239 | 193 | 160 |
| 76.1 | 65 | 2.500 | 5.920 | 6.630 | 8.020 | 169 | 151 | 125 |
| 88.9 | 80 | 3.000 | 6.980 | 8.640 | 10.300 | 143 | 116 | 98 |
| 101.6 | 90 | 3.500 | 8.920 | 9.900 | 11.800 | 112 | 101 | 84.7 |
| 114.3 | 100 | 4.000 | 10.200 | 12.400 | 14.700 | 98 | 80.6 | 68.0 |
| 139.7 | 125 | 5.000 | ------ | 16.700 | 18.300 | ------ | 59.9 | 54.6 |
| 165.1 | 150 | 6.000 | ------ | 19.800 | 21.800 | ------ | 50.5 | 45.9 |

**Note:** The above weights are for black pipes and theoretical weights of galvanized pipes are 6% higher.

**16.13 Water Fittings**

**16.13.1 Full Way Gate Valves**

The full way gate valves shall be of heavy gunmetal conforming to IS: 778 – 1984 with latest amendments.

**16.13.2 Stop Cocks and Bib Taps**

Stop cocks and bib taps shall be of brass chromium plated. These shall be of heavy type having bright finish and conforming to IS: 781 – 1964 with latest amendments.

**16.15.3 Pillar Taps**

Pillar Taps shall be conforming to IS: 1795 – 1982 with latest amendments.

**16.15.4 Ball Valves**

The ball valves shall be of high pressure or low pressure type and shall be of the size as specified. The body of the ball valve shall be capable to withstand a pressure of 14 kg / Sqcm. A high pressure ball valve with the float immersed to not more than half of its volume shall remain closed against a test pressure of 10.5kg / Sqcm. and a low pressure ball valve against a test pressure of 3.5kg / Sqcm. The ball valves shall conform to IS: 1703 – 1977 with latest amendments.

**16.16 Water Tanks**

Each overhead water storage tank shall be provided with sockets for inlet, outlet, overflow, scour and vent of required sizes. The overflow and vent shall be fixed with mosquito proof brass grating of approved design.

**16.16.1 Ferro cement Water Tank**

Ferro cement water tank shall be made of cement mortar 1: 2 (1 cement: 2 coarse sand) and layers wire mesh closely bound together to create a stiff structural form, absolutely free from cracks and other defects. Skeletal steel shall be 3 – 8mm MS wires with wire mesh of galvanised wires of 24 gauge woven with hexagonal opening of 6 – 20mm, on both sides of skeleton. Final membrane of steel mesh shall leave no space greater than 1cm. Super plasticizers shall be added to mortar to increase workability. Water cement ratio of mortar shall be below 0.5. The minimum strength of mortar cubes having surface area of 50 Sqcm. shall be 25 N / Sqmm. Ferro cement surfaces shall be cured for at least 10 days, by covering with hessian and profuse water spraying. Base of water tank shall be minimum 40mm thick in 1:1.5:3 (1 cement: 1.5 coarse sand: 3 stone aggregate 12.5mm nominal size) RCC. Shell thickness shall not be more than 25 mm.

Vertical shell and top of water tank shall be casted in single piece. Base and shell shall be properly anchored to create a stiff structural form. Inside of tank shall be painted with anti fungal paint.

**16.16.2 Fibre Reinforced Glass Water Tanks**

Fibre reinforced glass water tanks shall be made of food grade polyester resign, single piece cast in approved colour and shade, suitably moulded, non-breakable, sturdy with necessary stiffeners and ribs as required, minimum 4mm thick shell with 350mm dia lockable hinged cover, 20mm dia G.I. inlet and outlet scour and over flow and vent connections of 20mm each, all with flanged joints. The tank shall retain potability of stored water. There should not be any fungal termination in the terms, inside shall be coated with good graded anti fungal paint, if required. The tank throughout its body shall be stress and strain free, watertight and should not be prone to deformation.

**16.16.3 Outlets**

The outlet pipe shall be fixed 50 to 75mm above the bottom of the tank and provided with copper gauge stainers.

**16.16.4 Wash Out (Scour)**

The wash out or draining pipe shall be made flush with the bottom of the tank at it lowest point.

**16.16.5 Overflow**

The overflow pipe shall be one size higher than the inlet pipe and provided with copper gauge stainers. The water level of the tank shall be set below the overflow level at a

distance of not less than 25mm or of not less than the internal diameter of the pipe, whichever is greater.

### 16.17 External Water Supply

#### 16.17.1 Rigid PVC Pipes

The unplasticized PVC pipes shall be of class as specified in the BOQ conforming to IS: 4985 – 1988.

The pipes shall be with socket and spigot suitable for solvent welded joints (non heat application method). The solvent cement shall conform to IS: 14182 – 1994.

The dimensions, wall thickness, standard lengths shall be as per IS: 4985 with ISI marking indicating pressure head.

Proper care shall be taken for transport of pipes on flat bed of vehicles. Each pipe shall be uniformly supported along its length and overhanging of pipes by more than 1m shall not be allowed. The pipes shall be stacked on levelled ground free from rough surface, loose stones, etc. Storage of pipes shall be done as per IS: 7634 (Part III) in cool, covered dry place. Pipes of different sizes shall be stacked separately.

#### 16.17.2 PVC fittings

PVC fittings shall be injection moulded with solvent cement joints confirming to IS: 7834 – 1975. Fabricated PVC fittings shall not be used.

#### 16.17.3 GI Pipes

The pipes shall confirm to IS: 1239 (Part – I) 1990.

The dimensions wall thickness and standard lengths shall be as per IS: 12315.

The tubes shall be galvanised with zinc coating from inside and outside as per IS: 4736 – 1986. The galvanised pipe shall be capable of being bent cold without cracking of steel through $90^{o}$ C rolled a former having a radius at the bottom of groove equal to eight times, the outside dia of pipe. Each pipe shall be tested for hydrostatic test for leak tightness as per Clause 13.1 of IS: 1239 – 19815.

#### 16.17.4 Fittings

The fittings shall be as per IS: 1239 (Part – II) – 1992.

Other fittings shall be manufactured from mild steel by any approved process.

Unless otherwise specified by the purchaser, all fittings shall be manufactured with thread connections complying with requirements of IS: 1554 – 1985.

#### 16.17.5 Excavation of Trenches

Trenches for laying of pipes shall be of sufficient width to provide free working space on each side of the pipe. The free working space shall be preferably 250mm on either side. If the sides of the trench are not vertical, the toes of side slopes shall end at top of pipe and practically vertical sided trench shall be dug from these down to sub grade.

Not more than 100m run of pipe trench shall be opened up ahead of pipe laying operations unless otherwise approved by the Engineer.

The trenches shall be kept dry and free from water until the joints are made. The Tenderer shall keep the sub soil water or accumulated water at a level lower than the bottom of all permanent works for such periods as the Engineer may direct. All proposed methods of dewatering of trenches shall be the responsibility of the Tenderer for the duration of the contract.

#### 16.17.6 Laying of Pipes in Trenches

The pipe line alignments shown in the drawings are only tentative. The exact location of pipe line, etc. shall be decided by the Engineer at site.

**16.17.7 Pipe Bedding and Back fill**

Pipes laid in trenches shall be bedded evenly and firmly as far up the haunches of pipes as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom to the trench to fit the curve of the pipe or compacting the earth under and around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

The trenches shall be backfilled immediately after the pipes are laid, to a depth of 30cm above the pipe.

Filling up the trench shall be carried on simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur.

**16.17.8 Sand Bedding**

Pipes shall be laid in trenches on a well compacted bed of sand fill material as shown on the drawings extending for the full width of the trench and with sufficient material at the sides to permit the pipes to be worked into the pipe bedding material and firmly supported to true line and level. Sufficient space shall be left to enable the joints to be made tested and inspected but the Tenderer shall ensure that at least three quarters of the pipe length is fully supported. After the pipeline has been tested and approved by the Engineer, the trench shall be carefully filled in layers not exceeding 150mm to the required levels.

**16.17.9 Laying Pipes – General**

Pipes shall be laid generally from downstream end to upstream end. Pipes and fittings shall be examined for damage and carefully brushed out immediately before laying. The formation of excavation for pipelines shall be firm, dry, even, true to grade, free of stones and other protrusions and compacted to a minimum of 90% Proctor Density before placing of pipe bedding. Each pipe shall be laid accurately to line and gradient so that except where otherwise specified or ordered by the Engineer the finished pipeline shall be in a straight line both in horizontal and vertical planes. The maximum length of pipeline permitted in any individual line shall be limited to the section between two adjacent manholes or chambers. Where instructed by the Engineer, the Tenderer shall arrange for an approved independent laboratory to carry out tests to determine the insitu density of the pipe bedding material. The Tenderer shall provide fix and maintain at such points as may be directed by the Engineer properly painted sight rails and boning rods of predetermined measurement for the boning in of individual pipes to correct alignment. The sight rails shall be situated vertically above the line of pipes or immediately adjacent thereto and there shall at no time be less than three sight rails in position on each length of pipeline under construction to any one gradient. Consideration will be given by the Engineer to any alternative method for controlling alignment such as laser beam instrument. Where pipelines are to be constructed in the tunnel heading or duct provided by the Tenderer the minimum clearance between the inside face of the tunnel heading or duct and the pipe shall be 150 mm unless otherwise shown on the drawings.

The Tenderer shall adopt a suitable method of controlling the alignment of a pipeline installed in a tunnel heading or duct to the approval of the Engineer.

**16.17.10 Sluice Valve**

Sluice Valves shall be of the specified size and class and shall in all respects conform to the latest IS: 780, IS : 2666 with latest amendments. Class I sluice valves shall be used for a maximum working pressure of 10kg / Sqcm. and Class II sluice valves for 15kg / Sqcm. The valve shall be fully examined and cleared of all foreign matter before being fixed. The fixing of the valve shall be done by means of bolts, nuts and 3mm rubber insertion or chemically treated compressed fibre board 1.5mm minimum thickness and of weight not less than 0.183gm / Sqcm. with the flanges of spigot and the socketted tail pieces drilled to the same specification in case of S & S pipes and with flange in case of

flanged pipes. The tail pieces shall conform to IS: 1938 – 1976. These shall be joined to the pipeline by means of lead caulked joints. The sluice valve shall be provided along with key to operate from the ground.

**16.18 External Water Supply**

**16.18.1 Cast Iron Pipes and Specials**

All pipes and specials for water supply shall be of cast or spun iron straight with spigot and socket ends and shall conform to the latest edition of the IS specification for Class 'B' pipes. Heavier quality pipes and specials shall be used when the water pressure exceeds 122m (400ft.) of head, flanged end pipes may also be used where required and specifically approved. All pipes and specials shall be coated inside and outside while hot with Dr. Angus Smith's solution or other approved anti corrosive paint.

**16.18.2 Trenches for C.I. pipes and Specials**

Trenches shall be excavated as described under "Drainage" for S.W. Pipes.

**16.18.3 Laying**

Before laying the pipes, they shall be examined to see that there are no cracks or defects. Subject to the approval of the Engineer, the damaged portion of the cracked pipe may be cut at a point not less than 15cm. beyond the visible extremity of the crack with diamond pointed chisel. The pipes shall be thoroughly cleaned off of all dust and dirt. Special care shall be taken to clean the inside of the sockets and the outside of the spigots before lowering the pipes into the trenches. Holes to receive the sockets shall be scooped out in the trench bed so as to firmly bed he full length of the pipe. The pipes shall be lowered into the trench by means of suitable pulley blocks, shear legs, chains, ropes, etc. In no case the pipes shall be rolled and dropped into the trench. After lowering the pipes, they shall be arranged to coincide the centre line of pipes with the centre line of alignment. The spigot of one pipe shall be carefully centered into the socket of the next pipe and driven to the full distance that it can go and the pipe line laid to levels required, being kept in position by earth filling, well watered and rammed at two or more places in its length. Specials shall also be laid in their proper positions as stated above. The pipes shall be laid with socket facing the direction of flow of water facing uphill. At the end of each day's work, the last pipe to be laid shall have its open end securely closed with a wooden plug, to avoid rats and other small animals getting in. Cement concrete thrust blocks of suitable design shall be provided at $45^0$ and $90^0$ bends of the pipes so that to withstand dynamic and static forces likely to be developed due to water running through the pipes. The thrust blocks shall be made after the joints have been caulked with lead and these shall be paid for separately, unless otherwise specified.

**16.18.4 Lead Caulked Joints**

**Lead for Joints:** It shall be bluish grey in colour, very soft and malleable, readily melted, free from mixture of zinc or tin.

**Spun Yarn for Joints:** This shall be of best quality preferably white. It shall be free from dust etc. It shall be soaked into hot coal tar or bitumen and dried before use.

**Joints:** The spigot shall be carefully centered in the socket by two or three laps of treated spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket, leaving the requisite depth for the lead. The laps of the yarn must be longer than the circumference of the pipe. No making up of the pieces shall be allowed. The leading of the pipes, etc. shall be done by means of ropes covered with clay or by using special leading rings. The lead shall be rendered thoroughly fluid and each joint shall be filled in one pouring.

**Caulking:** After the joints have been run, they shall be thoroughly caulked until they are perfectly watertight. Caulking of joints shall be done after a convenient length of pipes has been laid. The leading rings shall first be removed with a flat chisel and then the joint caulked round three times with caulking tools of increasing thickness and a hammer of 2 to 3kg (4 to 6 lbs.) weight. Lead joints shall not be covered till the pipeline has been tested under pressure but the rest of pipeline may be covered to prevent expansion and contraction due to variation in temperature. When it is inconvenient or dangerous to use molten lead for joints, they may be made with lead wool inserted in strings not less than 6mm (1/4") thick and thoroughly caulked if approved by the Engineer. When it is inconvenient or dangerous to use molten lead for joints, they may be made with lead wool inserted in strings not less than 6mm (1/4") thick and thoroughly caulked if approved by the Engineer.

**Testing:** The joints and pipes laid for water supply system shall be tested to a pressure of 12kg. per Sqcm. for two hours without developing leaks / fall in pressure of such head as otherwise specified after being caulked and should may leakage occur, the leaky joint or joints shall be remade and section retested at Tenderer's own expense, until satisfactory results are obtained.

**Painting:** Pipes laid under floor / ground shall be given two coat of bitumastic paint.

### 16.19 Sluice Valves

The valve shall be of the specified size and shall be of approved quality. The body and cover of the valve shall be of tough, homogeneous cast iron, the spindle of forged bronze, the nut and the valve seats of high grade gun metal and machine – faced. It shall be fitted with a C.I. wheel or a cap of standard type, marked with an arrow to show the direction of turn for opening of the valve. It shall have flanged ends drilled to Indian Standard Specifications. The valves shall work easily and smoothly under all conditions and shall be watertight when closed under the working pressure as stipulated in the relevant IS. Unless otherwise specified, valves shall be Class II type as in IS: 778 – 1971. The diameter of the waterway, when the valve is fully opened shall not be less than the diameter of the pipe.

#### 16.19.1 Fixing

Fixing of the valve shall be done by means of bolts, nuts and 3 mm (1/8") rubber insertions with the flanges of the spigot and socket tail pieces drilled to the same specifications. The tail pieces shall be jointed to the pipeline by means of lead caulked joints.

### 16.20 Butterfly Valves

Valves above 50 mm dia shall be butterfly valves. Butterfly valves shall conform to the following specification:

| | | |
|---|---|---|
| Body | : | High duty cast iron to IS: 210 FG 220 and BS 1452 Gr. 220 |
| Seating: | Moulded in sit resilient lining of black nitrite rubber. | |
| Disk | : | Nylon coated S.G. iron to IS: 1865 / SG 400/12 and BS 2729 Gr. 470/12 |
| Shaft | : | The shafts are made of stainless steel AISI 431. Only flanged and valves to be used with flanges drilled to BS 10 Table F. Valves shall be capable of being locked in open position. Hand wheel shall be with flow control lever unit for smooth opening and closing of the valve. Key rods with MS coated extended spindles to be provided whenever the valves are not approachable from the ground surface. |

**16.21 Appurtenances**

The other appurtenances of the pipeline are mentioned below.

**Air Valves:** These are placed at every summit in the pipeline to permit the escape of air when the main is filled and afterwards air if any is carried into the main (they are also placed on long stretches of nearly level main).

**Scour Valves:** These are placed at the bottom of all depressions for emptying the main or letting out sediment.

**Reflux Valves:** These are fixed on the ascending parts of the main, which open in the direction of flow, but automatically close if a burst occurs and when the water flows back. They diminish the damage done by the escape of water at a burst.

**Safety or Relief Valves:** These are fixed at the down stream ends of long lengths of mains or where water hammer may take place so as to reduce to the normal any excessive pressure that may occur.

**Fire Hydrants:** These shall be of approved design and be fixed as shown on the drawings and as per the Engineer's direction. The cost of hydrant shall include cost of valve and masonry chamber as shown on the drawings with C.I. cover, etc. complete with two coats of enamel paint over a coat of primer.

**Water Meter:** It shall consist of meter, 'Y' strainer and other accessories shall be fixed as per the requirement of the Local Water Supply Authority. The cost of meter shall include the cost of testing and sealing by Municipal Authorities and fixing including a masonry chamber as shown on the drawing. C.I. cover and locking arrangement complete as directed.

Manhole chambers and surface chambers for housing valves, etc. shall be constructed as per standard drawings.

**16.22 Septic Tank and Effluent Disposal**

**16.22.1 Septic Tank**

Septic Tank shall consist of the tank itself with inlet and outlets and complete with all necessary earthwork and back filling. This item shall also include ventilating pipe of at least 100mm dia whose top shall be provided with a suitable mosquito proof wire mesh and cowl. Ventilating pipe shall extend to a height of above 2m when the septic tank is at least 15m away from the nearest building and to a height of 2m above the top of building when it is located closer than 15m. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

**16.22.2 Effluent Disposal**

The effluent from the septic tank shall be disposed by allowing it into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed S.W. pipes laid in a trench filled with broken bricks.

**16.22.3 Soak Pit**

The soak pit shall be complete as shown on drawing. In absence of a detailed drawing it shall consist of a 900mm dia pit, 1000mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone bricks or concrete blocks set in cement mortar (1:6) and filled with brick bats. Inlet pipes shall be taken down to a depth of 900mm from the top as an anti mosquito measure.

**16.22.4 Open Jointed S.W. Pipes**

Minimum dia of the S.W. pipes shall be 200mm nominal. The trench for laying the pipe shall be minimum 600 X 600mm. The joints of the pipes shall be left unsealed.

**16.22.5 Commissioning Septic Tank**

After the Septic Tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow dung may be introduced.

**16.23 Testing and Acceptance**

**16.23.1 Inspection Before Installation**

All pipes, fittings and fixtures shall be inspected before delivery at the site to see whether they conform to accepted standards. The pipes shall again be inspected on site before laying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.

**16.23.2 Testing of Pipelines for Drainage and Sanitation**

Comprehensive test of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

**General guidance for the tests are given below.**

- **Smoke Tests**

  All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a Smoke Test connected under a pressure of 25mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

- **Water Test for Pipes other than Cast Iron**

  Glazed ware pipes shall be subjected to a test pressure of at least 1.5m head of water at the highest point of the section under test. The tolerance figure of two litres per centimeter of diameter per kilometer be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, filling the system with water. A knuckle bend shall be temporarily jointed in at the top and a sufficient length of the vertical pipe jointed to it so to provide the required test head or the top may be plugged with connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitable for observation.

**Subsidence of test water may be due to one or more of the following causes.**

- Absorption by pipes and joints.
- Sweating of pipes or joints.
- Leakage at joints or from defective pipes.
- Trapped air.

Allowance shall be made for the first cause by adding water until absorption has ceased and after which the proper tests should commence. Any leakage and the defective part of the work shall be cut out and made good.

- **For Cast Iron Pipes**
  Cast Iron sewers and drains shall be tested as for glazed ware and concrete pipes. The drain plug shall be suitably strutted to prevent their being forced out of the pipe during the test.

- **For Straightness**
  By inserting at the high end of the sewer or drain a smooth ball of a diameter 13mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball with roll down the invert of the pipe and emerge at the lower end; and
  By means of mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight.

- **Testing of Septic Tank**
  The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15mm.

- **Fixtures, etc.**
  All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted.

### 16.24 List of Approved Brand / Make / Manufacture

| | | |
|---|---|---|
| PROCELAIN WARES | : | PARRYWARE / HSW |
| G.I. PIPES | : | TATA / ST / JINDAL |
| G.I. FITTINGS | : | 'R' BRAND |
| PVC PIPES | : | FINOLEX / SUPREME / TRUBORE |
| PVC FITTINGS | : | PRINCE / INFRA /SUPREME |
| C.P. FITTINGS | : | METRO / ESSCO /JAQUAR |
| BALL VALVES | : | AUDCO / BDK / VALTEC |
| GATE VALVES | : | LEADER / NETA |
| PLASTIC TANK | : | SINTEX / INFRA |
| FLUSHING CISTERN | : | COMMANDER / SLIM LINE |
| SEAT COVER | : | COMMANDER / PATEL |
| MIRROR | : | MODIGUARD / ASAHI |
| BUTTERFLY VALVES | : | AUDCO / BDK |
| S.W. PIPES | : | ANDHRA / DALMIA |
| C.I. PIPES | : | NECO / BIK |
| PUMPS | : | BEST / TEXMO |
| H.D.P.E. PIPES | : | MANIKYA / HASTI /PLASTICHEM |

### 16.25 Galvanised Iron Pipes and Fittings

#### 16.25.1 Specifications

Where specified GI pipes for water supply inside and outside the buildings shall be genuine galvanized steel tubes conforming to IS: 1239 – 1969 of specified grade with latest amendments. All fittings shall be malleable iron galvanized fittings conforming to IS: 1239 (Part II) – 1969 with latest amendments. All fittings shall have manufacturer's trademark stamped on it. Fittings in GI pipelines shall include elbows, tees, bends, reducers, nipples, union bushes, GI clamps of approved design, GI flanges with 3mm rubber insertion, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's

work. Tenderers may be required to produce certificate to this effect from the manufacturer.

**16.25.2 Laying and Fixing**

Screwed GI pipes shall be joined with screwed socket points, using screwed fittings. Care shall be taken to remove any burr from the end of the pipes after cutting, while lead with grommet of a few strands of fine hemp shall be applied while tightening. Other pipe joining compound may be permitted if approved by the Engineer before starting the work. All pipes shall be fixed with GI holder bat clamps to clear off the wall. If pipes are fixed in chases they shall be fixed in position by iron hooks. All piping shall be kept plugged at the end of day's work. Pipe shall be laid evenly, painted with two coats of anti corrosive bitumastic paint and covered with fine sand 150mm all around. The pipes in chases shall be painted with bitumastic paint.

**16.25.3 Depth of Cover for Underground Water Pipes**

The cover for the mains shall be at least 90cm under vehicular area and 75cm in pedestrian area.

**16.25.4 Non Return Valves**

The valves shall be of quality approved by the Engineer and shall generally conform to IS : 778 – 1971 with latest amendments.

**16.25.5 Valve Chamber**

**a. Constructions**

Base concrete, masonry work and plastering shall be as described under sub section of manholes.

**b. Size**

The size of the valve chamber shall be as specified in the Bill of Quantities.

**16.26 Sanitary Fixtures & Fittings**

**16.26.1 Workmanship**

All sanitaryware shall be fixed in a neat workmanship like manner, true to level and plumb. Manufacturer's instructions shall be followed closely regarding the installation and commissioning.

**16.26.2 Sanitaryware**

All porcelain sanitaryware shall be of approved make. All fittings shall be of first quality, free from warps, cracks and glazing defects. All sanitaryware fittings and fixtures shall be as shown in drawings and Bill of Quantities. All vitreous sanitary appliances (vitreous chine) shall be conforming to IS: 2556 with latest amendments. Kitchen sinks shall be of white glazed fire clay conforming to IS : 771 (Part 2) – 1985 with latest amendments.

**16.26.3 Fixing**

All fixtures shall be fixed with chromium plated brass screws with washers wherever necessary.

**16.26.4 Painting**

The high level Cast Iron Flushing Cisterns and GI flues pipes shall be painted with one coat of red oxide and 3 coats of paint of approved shade and quality. All supporting brackets for cisterns, wash basins and sinks shall also be painted as directed by the Engineer. Fixtures shall be protected throughout the progress of the work from damage.

Special care shall be taken to prevent damage and scratching of chromium plated fitting. Tool marks on chromium fixtures, etc. shall not be accepted.

### 16.27 Plant and Machinery

**General**

All plant and equipment shall be new and of appropriate grade and quality suitable for and adequately, protected against the prevailing climatic conditions and in accordance with specifications and shall be of approved manufacture. Any plant, which is found to be unsuitable for use under these conditions, shall be dismantled and replaced by suitable plant entirely at the expense of the Tenderer. The complete installation shall be carried out in a neat and orderly manner by competent personnel with adequate experience of respective trade of work. Materials shall be the best of their type available and shall conform to the appropriate standards. Materials of construction shall be certified by a recognised testing authority and shall be suitable for use in the stipulated environment. Installation of materials and equipment shall be strictly in accordance with manufacturer's recommendation.

### 16.28 Testing and Commissioning

#### 16.28.1 General

The Tenderer shall be responsible for testing and commissioning the entire services, installations described in these specifications and will demonstrate the operation of the system to the entire satisfaction of and approval of the Engineer.

#### 16.28.2 Methods of Testing

The tests on various services shall be carried out as described herein. The carrying out and recording of tests shall be agreed with the Engineer.

#### 16.28.3 Water for Testing

Water for testing shall be obtained by the Tenderer from an approved source. It shall be free from bacterial contamination, silt, grit, sand, etc. After testing, the Tenderer shall satisfactorily dispose off all water, or it may be reused provided it is clean and it not contaminated.

#### 16.28.4 Test Records

The Tenderer shall be responsible for keeping all records of tests and on completion, shall provide records and reports of the tests in triplicate. All test records shall clearly identify the item of the test and must be signed by a witness to the test.

#### 16.28.5 Unsatisfactory Works

If the tests reveal unsatisfactory materials, installation or adjustment, the Tenderer shall, at his own expense, carry out such alterations or replacement as may be necessary to rectify the defective work. The Tenderer shall then repeat the tests as necessary to establish the satisfactory nature of the alterations or replacements.

#### 16.28.6 Testing at Works

All plants and equipment shall be tested at maker's workshop before despatch and the test certificate in duplicate shall be forwarded to the Engineer. The Tenderer shall similarly provide a set of manufacturer's certified test curves for any pump installed under the Contract. All tests shall be in accordance with the appropriate Indian Standards.

#### 16.28.7 On Site Testing

The Tenderer shall provide on site all the necessary instruments, plants, equipment, materials, water electricity and labour necessary for carrying out the specified tests. All tests shall be carried out as required to meet the construction programme and the Tenderer shall include for all necessary installation and other works as may be required for testing the whole or parts of the installation. The Tenderer shall also be responsible for re testing, if necessary, until satisfactory tests are achieved.

**16.28.8 Test Records**

| Pipe Line | Test Pressure | Period | Method |
|---|---|---|---|
| Water Mains, Fair Mains & Water Services | 5kg / Sqcm. or max. Working pressure plus 50% which ever is greater. | 2 hours | Hydraulic Pressure Test |
| Underground Drainage | 1.5 metres head of water at highest point | 30 min test | Hydraulic Test |
| Foul Drainage above ground | i. Not more than 4.5 M head in pipe<br>ii. 75 mm water gauge | 2 hours<br>3 minutes | Hydraulic Test<br>Air test |

**16.28.9 Testing of Various Services**

**a. Water Services**

Before the pipes for water supply are painted or covered, they shall be tested to a hydraulic pressure of 5kg / Sqcm. or maximum working pressure plus 50%, whichever is greater. Pressure shall be maintained for at least 2 hours without appreciable drop in pressure. In addition to the sectional testing of water supply pipes, the Tenderer shall test the entire installation on completion of the job to the entire satisfaction of the Engineer. The Tenderer shall rectify all leakage and restore damage done to the building and furniture at his own cost.

**b. Underground Drainage**

The sewer and drain lines shall be tested for water tightness and straightness as described below.

**i. Water Test**

Pipes and joints shall be subjected to a test pressure of at least 1.5m head of water at the highest point of the section under test. The test shall be carried out by suitably plugging the low end of the drain and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so that to provide the required head. Or top end may be plugged with a connection to a hose ending in a funnel, which could be raised or lowered till the required head is obtained and fixed suitably for observation.

**ii. Test for Straightness and Obstruction:**

Sewer lines shall be tested for straightness

- By inserting at the high end of the sewer or drain a smooth ball of diameter 13mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball should roll down the invert of the pipe and emerge at the lower end; and
- By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light can be observed. If the pipeline is not straight, this will be apparent. The mirror will also indicate obstruction in the barrel.
-

**c.Above Ground Foul Drainage**

All soil, waste and vent pipes shall be tested by filling up the whole or part of stack with water. All openings for connections, etc. shall be suitable plugged. The total head shall, however, not exceed 4.5m. The Tenderer shall remove and replace all pipes having holes, cracks, etc. All leaking joints and access doors shall be replaced or remade to the entire satisfaction of the Engineer. Water shall be retained in stack for a minimum period of 2 hours. After all plumbing fixtures are installed, the Tenderer shall apply the smoke test to the entire stack to the satisfaction of the Engineer.

**d. Sanitary Fixtures & Fittings**

When the installations has been completed to the satisfaction of the Engineer, it shall be tested in the following manner.

- The entire system shall be slowly filled with water, allowing any trapped air to escape.
- When all outlets are closed, the system shall be checked for water tightness.
- Each outlet shall then be checked for rate of flow and correct operation.
- Waste outlets of wash basins and sinks shall be plugged and the basin and sink bowls shall be filled up to overflow level. Plug shall be removed and waste pipe and trap shall be checked for leakage and floor drain (if fixture waste is connected to floor drain) shall be checked to overflow.

**e.Testing Manholes**

All open channel manholes shall be tested with water to a height of 1m above the channel invert or as otherwise directed. The water level shall be retained for 2 hours period without appreciable loss. When the water is released, the benching shall be inspected to ensure that there are no cracks.

**f. Flushing Out and Sterilisation of Pipe Work and Tanks**

It is essential that all internal water services, external mains and tanks are thoroughly flushed out prior to being put into service and that drinking and domestic water services mains and tanks are sterilised in accordance with Clause 13 of IS: 2065 – 1962 – Code of Practice with latest amendments for Water Supply in Buildings. The Tenderer shall be responsible for making any temporary pipe work connections required. Following the completion of sterilisation of every part of the drinking a domestic water system, the Tenderer is to ensure that satisfactory bacteriological samples are obtained and tested at an approved laboratory and the results approved by the Engineer prior to completion of the Tenderer and handing over to the BDA.

**16.29 'AS FITTED' Drawings and Operation and Maintenance Manuals**

The Tenderer shall submit, after the completion of the work, set of originals and two sets of prints of the "As Fitted" drawings, giving the following information.

a. Position of all sanitary fittings.
b. Runs of all piping and diameters on all floors and vertical stacks.
c. Position of control valves, access panels and all other plant and equipment.
d. IL of all manholes.

**Operation and Maintenance Manuals**

The Tenderer shall hand over to the Engineer, all Operation & Maintenance Manuals of the plants and equipment supplied and installed by him. Only manufacturers catalogues, wiring diagrams and installation drawings, relevant to particular items of equipment concerned shall be submitted. General catalogues shall not be acceptable.

**16.30 Trade Preamble**

**(i) Manholes, Masonry Chambers for Valves, Hydrants and other Appurtenances**

Manholes and other chambers shall be measured in number. The rates shall include

a. Excavation in any kind of solid including quick sand but excluding rock.
b. Protecting the excavation with all necessary shoring, strutting and keeping the excavation clear of water.
c. Providing and laying foundation concrete as shown on drawing and as specified.
d. Providing and constructing brick masonry walls in cement mortar as shown on drawing and as specified. The openings required to be left open for pipes and subsequent grouting shall also be included in the rates.
e. Providing and casting RCC cover as shown in drawing and as specified.
f. Providing, fitting and fixing C.I. surface box, manhole cover as shown in drawing and as specified and / or directed at site by Engineer / Engineer's Representative, and
g. Providing cement plastering to the walls of chamber, internally as well as externally.
h. For manholes the rates shall include the cost of C.I. / G.I. foot rests. The depth of the manhole shall be reckoned from the top level of C.I. cover to the invert level of channel. The extra depth shall be measured and paid as extra over the specified depth.

**(ii) Pipe Work**

a. Pipe work shall be measured in running metre nearest to a cm as laid or fixed from inside of one manhole to inside of the other manhole. The length shall be taken along the centre lines of the pipes over all fittings such as bends, junctions, etc. which shall not be measured separately.
b. The rate shall include the cost of excavation in trenches, dressing, supplying, lowering, laying, jointing and testing of pipes, cement concrete encasing, back filling and disposal of surplus earth.

**(iii) Soil, Waste & Ventilation Pipe Work**

a. Pipe work shall be measured in running metres nearest to a cm. as fixed or laid. The length shall be taken along the center line of the pipes over all the fittings, such as bends, tees, junction all with or without doors, door pieces, cowls, etc., which shall not be measured separately.
b. The rate shall include the cost of materials and labour involved in supplying, fixing with holder bats and MS Stays, laying underground cutting holes, chases in walls, floors and painting two or more coats of enamel paint of approved quality and shade over a coat of primer. The rate shall be inclusive of cost of materials and labour, cutting holes and closing in walls and floors and making good the same, providing sleeves etc. and encasing pipes laid under floor / ground with 50mm thick cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate 20mm nominal size) alround.
c.

**(iv) Floor Traps**

Floor traps shall be measured by number. The rate shall be inclusive of supplying of trap and grating, setting in concrete and connecting branch pipes to it.

**(v) GI Pipes for Water Supply (External)**

a. Pipe work is to be measured in running metres nearest to a cm. For the finished work, which shall include GI pipe and GI fittings such as bends, tees, elbows, reducers, unions, crosses, plugs, nipples and nuts but shall exclude brass or gunmetal taps, valves, etc.
b. The rate shall be inclusive of the cost of materials and labour, excavation and earth work, painting pipes with two coats of anticorrosive paint and surrounding with sand 150mm all round.

**(vi) G.I. pipes for Water Supply (Internal)**

a. As (a) above.
b. The rate shall be inclusive of cost of materials and labour, cutting holes and chasing in walls, and floors and making good the same, providing sleeves, applying anticorrosive paint on buried and concealed pipe work and painting of exposed pipes with two coats of enamel paint over a coat of primer.

**(vii) Taps, Concealed Stop Cocks, Valves, etc.**

Appurtenances like taps, concealed cocks, valves, etc. shall be measured in number. Rates shall include

a. Testing and checking of appurtenances and fittings before taking delivery of the same.
b. Delivering the appurtenances to specified storage area at site.
c. Fixing the same at specified space, jointing, fitting and fixing true to line and level including repairing of protective coating, if necessary, and
d. Providing equipment, labours and materials necessary to carry out the above works complete to carry out the above works complete in all respects as specified and / or instructed.

**(viii)Sanitary Fixtures**

All sanitary fixtures of specified trade or equivalent shall be paid by number and rate shall include all C.P. brass fittings, flushing cistern (in case of W.C. and Urinal) specials, connection pipe and fixing component, brackets, screws, cutting holes in walls and making good the same.

The rate shall be inclusive of painting of RS or MS brackets for cistern, washbasins, sinks etc. with two coats of enamel paint over a coat of primer.

**(ix) Water Closet**

The rate of water closet shall be inclusive of supplying, installing, testing and commissioning the complete W.C. unit with cistern with ISI marked standard internal PVC fittings an all other fittings and interconnecting pipe work and CP brass angle valve on inlet to cistern with CP copper connection pipe.

**(x) Wash Basin**

The rate of wash basin shall be inclusive of supply, installing, testing and commissioning of the complete wash basin with CP waste CP bottle trap, a pair of CP pillar cock, CP brass angle valve on cold & hot inlets with CP copper connections pipes, etc.

# TECHNICAL SPECIFICATIONS FOR ELECTRIC WORKS

## 17.0 General

17.1 The electrical wiring installations shall be carried out in conformity with the requirements of he Indian Electricity Rules, 1956 as amended upto date and to the relevant regulations of the electric supply authority concerned, and IS: 732 Indian Standard Code of Practice for Electrical wiring installations.

17.2 All the equipment, fittings and accessories, materials selected for the wiring installations shall conform to the relevant Indian Standard wherever these exist. These shall be of makes as specified in the tender or as approved by the Engineer.

17.3 Looping back system of wiring shall be adopted.

17.4 A light circuit will not have more than total 10 points of lights, fans and 6 amps. Socket outlets or a load of 80° watts, whichever is less. Power Circuit will not have more than two outlets per circuit. Circuit wiring will form part of point wiring and no extra payment on this account will be entertained.

17.5 All the wiring shall be recessed conduit with PVC insulated, unsheathed, stranded, copper conductor wire of sizes 1.5Sqmm. for light points / circuits and 4 Sqmm. for power points / power, circuits having one outlet per circuit. The outlet from Distribution Board will be wired with 2.5 Sq mm for lighting circuits and 4 Sqmm for power circuits . insulated copper conductor FRLS wires.

17.6 Only IS marked PVC conduits (Medium) with suitable accessories, shall be used. Minimum size of conduit used, shall not be less than 20mm dia.

17.7 Separate conduits shall be laid for the wiring of lighting / fan points, circuits, power points including circuits, sub mains, telephone and TV system.

17.8 MS Junction boxes in the conduit run on walls wherever required should be provided with MS sheet covers of not less than 1.60mm thick. For PVC junction boxes on the ceiling or wall, rubber grommets shall be used to plug in unused entries.

17.9 Earthing wire Each light / power circuit shall not have less than 1.5/2.5 Sqmm PVC copper wire as independent earth continuity wire. The same shall be green coloured.

17.10 Location of the light and power points shall be as per the details in drawings and as approved by the Engineer.

17.11 Height of switch box (bottom) shall be 1.25m above the finished floor level and of 6 amps for TV and Telephone. 16 Amps socket outlet box (bottom) in kitchen will be 20 cm above the top of working platform and for geysers in Toilet shall be placed 500mm below the roof as per drawings. Light bracket / bulkhead / Fluorescent Tube fittings points shall be at 2.10m above finished floor level. Distribution box shall be at 1.8m above finished floor level. The heights given may be changed to suit local requirements and shall be approved finally by the Engineer. No extra claim of whatever nature will be entertained due to any change in location / mounting height.

## 17.12 Electrical Installations & Testing

Each light point / exhaust fan point shall comprise of providing and fixing recessed conduit including accessories, PVC insulated 1.5Sqmm. conductor cable, light point outlet box, 6 Amp. **Modular** switch with appropriate **modular** switch plate of specified brand/make etc. as required and complete with circuit wiring. This also includes continuous PVC insulated copper wire earthing (Green colour). Light point in stairs where specified shall be two way type each controlled by two no. of two way **modular** switches.

17.13 Each 3/5 pin 6 Amps. socket outlet points shall comprise providing and fixing out recessed conduit and accessories 1.5Sqmm.copper conductor PVC insulated cable, 6 Amps. 3/5 pin socket outlet and 6 amp. SP **MODULAR** Type switch in 16 SWG M.S. box with MODULAR sheet cover and earthing the earth pin of socket outlet with 14 SWG bare copper wire etc. complete as required.

17.14 Each ceiling fan / exhaust fan point shall comprise of providing and fixing recessed conduit including accessories, PVC insulated 1.5Sqmm. copper conductor, cables 1.5Sqmm. PVC insulated copper wire for earthing the fan regulator, 6 Amp SP MODULAR Type Switch in MODULAR sheet cover , 150mm hexagonal 16 SWG MS box foe fan clamp with 13mm dia, 450mm long MS rod, bent downwards at ends etc. complete as required. Circular 3mm laminated sheet cover shall be provided for fan box.

(a) 1.5Sqmm. PVC insulated copper wire shall be run for all lights and fan points wiring as continuous earth wire.
(b) All metallic fixture to be earthed.

17.15 Each 6 pin 16 Amps. socket outlet point shall comprise of providing and fixing recessed conduit including accessories, 4Sqmm., 6Sqmm. PVC insulated copper conductor cables, 16 Amps., 6 pin socket outlet. SP MODULAR type switch with MODULAR sheet cover and including Earthing of the earth pin of socket out let with 4Sqmm. PVC insulated copper wire complete as required.

17.16 Each call bell point shall comprise of providing and fixing recessed conduit including accessories PVC insulated, copper conductor cable, outlet junction box. 6 Amps. SP MODULAR type bell push in 16 SWG MS box with MODULAR sheet cover etc. complete as required.

17.17 Each telephone point shall comprise of 2 X 0.61mm dia PVC insulated and sheathed tinned, copper conductor cable, recessed conduit including providing and fixing of 6 Amps. 2 pin telephone socket outlet in 16 SWG MS box with MODULAR sheet cover suitable socket outlet for aerial wires.

17.18 TV antenna point comprises 25mm dia recessed conduit including providing TV cable and fixing suitable socket outlet in MS box with MODULAR sheet cover suitable socket outlet for aerial wires.

17.19 Sub mains and mains wiring comprising PVC insulated, copper conductor cables of required size (based on load of individual flat) in recessed conduit shall be provided. The size of the PVC conduit shall be as per relevant IS codes, amended upto date.

17.20 SPN / TPN Double Door Distribution Boards of required ways with 25/32/63A RCCB OR RCBO (where not specified) for incoming and 10 amps SP MCB for each light circuit, 16-20 amps SP MCB for each power circuit as per design approved by the Engineer-in-charge, will be provided. MCBs shall be of not less than 10 KA breaking capacity. TPN DB's shall have 16 Amps/25 amp capacity DP MCB for power equipment. All MCBs provided in the DBs shall be of "G" category. These boards shall conform to IS: 13032 with degree of protection I.P. 42.

17.21 All electrical wiring accessories such as MODULAR type switch, bell push, 6/16 amps socket outlets, telephone outlet, TV outlets, Ceiling Rose, Pendent. / batten holder etc. shall be of Anchor make as recommended catalogue type.

17.22 Porcelain connectors shall be installed at wiring terminals for fittings / fans, etc.

17.23 Luminaries / fans shall not be provided unless specified.

17.24 Earthing (Plate earth Electrode) conforming to IS: 3043 shall be provided.

17.25 On completion of the installations, following tests shall be carried out for each flat as laid down in IS: 732 and should give satisfactory results.

i. Insulation Resistance Test.
ii. Polarity Test of Switches.
iii. Earth Continuity Test.
iv. Earth Resistance Test.

17.26 Testing instruments, labour, material and other incidentals necessary to conduct the tests shall be provided by the Tenderer at his own cost. All the above tests shall be carried out preferably in presence of Engineer or his authorized representative and test result recorded in the test sheets.

17.27 The meter board shall be cubical type, made out of CRCA sheet not less than 2mm thick. It shall have the following compartments.

17.28 **LT PANEL:**

All the LT panel shall be totally enclosed, rigid, floor/pedestal mounted/ floor mounted, air insulation, cubicle type suitable for operation on three phase/single phase 415/230Volts, 50 Hz.

The LT panels shall be designed to withstand heaviest weather conditions at site, with ambient temperature up to 55degree Celsius 90% humidity & dusty weather.

Should confirm to Indian electricity act & rules.

**STRUCTURE:**

degree of protection being not less than IP-54, gaskets between all adjacent units and beneath, all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gaskets with rubber strips and shall be lockable.

All panels and covers shall be properly fitted and screwed with the frame and holes in the panel correctly positioned. Fixing screw shall enter into holes taped into an adequate thickness of metal or provided The LT panel shall be metal clad & enclosed & be fabricated out of high quality CRCA sheet & floor ball wall mounting type.

The panel shall be fabricated from CRCA sheet steel having following minimum thickness. Frames, load bearing members, back & side covers of panel shall be of 14 SWG. Partition & small doors shall be of 14SWG.

All CRCA sheet steel used in the construction of LT panel shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber material.

The LT panel shall totally enclosed, completely dust and vermin proof and
with hidden stainless steel hinges.

A suitable size base channel shall be provided at bottom.

LT panel shall be in multi-tier formation. The size of the LT panel shall be designed in such a way that the internal space is sufficient for hot air movement, and the electrical component does not attain temperature more than 40 degree Celsius. If necessary openings shall be provided for natural ventilation, but the said openings shall be screened with fine weld mesh.

Knockout holes of appropriate size & number shall be provided in the LT panel in conformity with number, and size of incoming and outgoing conduits/ cables using gland plates of 3mm thickness.

Alternatively the LT panel shall be provided with removable sheet plates of 3mm thickness at top/bottom to drill holes for cable/conduit entry at site.

The LT panel shall be designed to facilitate easy inspection, maintenance and repair.

Power/ control terminals in the cable alleys for each module & also the busbar chamber shall be covered with hinged & bolted type hylum shrouds respectively to prevent accidental contact when the door/ cover is withdrawn. In each feeder module, the phase barrier of hylum sheet shall be provided between adjacent phases.

All the feeder modules & the cables alleys are provided with hinged type doors and cam lock with key lock chromium plated, whereas all the busbar chambers are provided with bolted type doors.

**METAL TREATMENT AND PAINT FINISH:**

**PRE TREATMENT CHEMICAL PROCESS:**
All sheet steel work used in the construction of the panel shall be pre treated with 7 tank chemical process as specified in the specific requirement sheet before applying the two coats of zinc chromate primer followed by synthetic enamel/epoxy paint. The typical process is explained below.

**TANK CHEMICAL PROCESS:-**

**1. DEGREASING:-**
In this process the M.S sheets shall be effectively cleaned by dipping in hot alkaline degreasing solution for the period of about 10-20 minutes.

**2. WATER RINSING:-**
After degreasing process the M.S. sheets shall be rinsed in to the water for a period of about 1-2 minutes to remove the loosened oil, grease and adhering alkali from the surfaces.

**3. DERUSTING:-**
In this process the M.S. sheets shall be pickled in dilute sulphuric acid to remove oxide scales and rust formation for a period of about 30minutes.

**4. WATER RINSING:-**
After the derusting process the M.S. sheets shall be rinsed in to water for a period of about 1-2 minutes to remove the traces of acidic solution from the surface.

**5. PHOSPHATING:-**
In this process the M.S. sheets shall be dipped in to the zinc phosphate solution for a period of about 30minutes to facilitate durable coating of the paint on the metal process.

**6. WATER RINSING:-**
After the phosphating process the M.S. sheets shall be rinsed in to the water for a period of about 1-2minutes to remove the traces of phosphate solution from the surface.

**7. PASSIVATION:-**
In this process the M.S. sheets shall be dipped in to the de-oxalite solution for a period of about 1minute to retain and augment the effects of phosphating on the surface.

After completion of 7 tank process, a fine grained, smooth and compact coating of iron/zinc phosphate shall be produced, which is an excellent base for paint and provide under film protection against corrosion. The coating shall meet the Indian standard specification IS: 3618-1966 class c.

**DRYING:**
After the above pre treatment chemical process, the M.S. sheets shall be dried either by means of hot air calculation oven (stoving) or by means of blast of compressed air( air drying).

**PRIMER COATING:**
Primer coating with two coats of highly corrosion resistant zinc chromate primer shall be done before applying the final paint finish.

**PAINT FINISH:**
The final finish of synthetic enamel/epoxy paint of RAL-7032 shall be matt finish and powder coated.

**INSTRUMENT COMPARTMENT:-**
Separate and adequate compartment shall provide for accommodating instruments, indicating lamps, control contactors, relays and fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, switch disconnector fuse units, bus bars and connections.

**BUSBARS:-**
The Busbars shall be air insulated aluminum alloy as indicated and shall comply the following features:-

Uniform cross section with 35 degrees Celsius rise above ambient and with color coded PVC sleeves with minimum 40% de rating of bus bar sizes/amperage declared by busbar manufacturers of reputed make i.e. 1 AMP per 1.1 sqmm. Aluminum in LT panel.

Neutral bar 50% of phase bar.

Busbars should be supported by SMC/cast resin insulators suitable to withstand thermal and dynamic short circuit loads.

The busbar shall be air insulated and made of high quality, high conductivity, high strength copper or aluminum alloy strip ( as per BOQ) and as per relevant IS code. The busbar shall of three phases and neutral system with separate neutral and earth busbar. The branch busbar and interconnection between busbar and various components shall be of high conductivity, hard drawn, electrolytic copper or aluminum alloy strip. The busbar shall be of rectangular cross section designed to withstand full load current of phase busbar and full/ half rated current for neutral busbar as per BOQ and shall be extensible type on either side. The busbar shall be rated for the frame size of the main incoming breaker but in may case not less than 800 amp capacity. The busbar shall have uniform cross section through out the length.

The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be colour coded in red, yellow, blue, black to identify the three phases and neutral of the system. The busbar shall be supported on unbreakable, non hygroscopic DMC insulated supports at sufficiently close interval to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit.

The busbar shall be housed in separate compartment. The busbar shall be isolated with 3mm thick bakelite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbar are maintained as per below.

Between phases: 27mm minimum.
Between phases & neutral: 25mm minimum.
Between phases & earth: 25mm minimum.

All busbar connection shall be done by drilling holes in busbars and connecting by chromium plated brass bolt and nuts. Additional cross section of busbar shall be provided in all LT panel to cover up the holes drilled in the busbars. Spring and flat washers shall be used for tightening the bolts.

All connection between busbar and circuit breaker/ switches and between circuit breaker/switches and cable terminals shall be through solid copper strips or aluminum strips of proper size to carry full rated current. These strips shall be insulated with insulating strips.

i. Bus bar chamber with aluminium bus bars of adequate ratings, suitable for 415 volts, 3 phase, 50 cycles AC supply.
ii. Independent lockable compartment with hinged door, for each floor flats for housing KWH meter. For facilitating meter reading, cover shall be equipped with standard size window covered with 2mm transparent plastic sheet. Each meters shall be labeled as per the flat No by engraving only.. Suitable cable ally shall be provided for sub mains.
iii. MCB chamber flitted with suitable rate SPN / TPN MCB for independently controlling the supply of each flat and common area, hinged door having cutout for dolly / handle operation.
iv. All inter connected wiring of not less than 10Sqmm. PVC insulated, stranded copper conductor cable, between bus bar chamber to meter chambers and to MCB chambers. All termination of the wiring with the bus0bars shall be compressed sockets of suitable size.
v. Earthing connection at two points as required.
vi. The meter board shall be dust and vermin proof, free standing / wall mounted type. The design of the meter board will be as per requirements of SEB. PVC gasket shall be provided under the covers.
vii. Cable galleries shall be provided in the metering panel for easy run / termination of wiring.
viii. The meter board shall be painted with powder coating process of approved shade and manufacture.
OR
ix. The meter cubicle shall be of approved design as per requirements of the State Electricity Board.

**ELECTRICAL POWER AND CONTROL WIRING CONNECTION**

Terminal for both incoming and outgoing cable shall be suitable for 1100 volts grade Aluminum / Copper conductor PVC insulated and sheathed armoured cable and shall be suitable for connections for the cable size as per standard practice.

Both control and power wiring shall be brought out in cable alley for ease of external connections operation and maintenance.

Both control and power terminals shall properly be shrouded.

10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire connected per terminal.

Terminal strip for power and control shall preferably be separated from each other by suitable barriers of enclosures.

Particular care shall be taken to ensure that the layout of wiring neat and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate and testing.

Washers shall be used for all copper and aluminum connections

**TERMINALS**
The outgoing terminals and neural link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformer for instrument metering shall mount on the disconnecting type terminal blocks. No direct connection of incoming and outgoing cables to internal components connection of the distribution board is permitted only one conductor may be connected in one terminal.

**WIREWAYS**
A horizontal PVC wire way with screwed covers shall provided at the top to take interconnecting control wiring between different vertical section.

**CABLE COMPARTMENT**
Cable compartment of adequate size shall be provided in the LTpanel for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate support shall be provided in the cable compartment shall be brought out to terminal blocks in the cable compartment.

**EARTHING**
Copper earth busbar of 25mm X 3mm / GI earth busbar of 50mmx6mm shall be provided in the LT panel for the entire length of panel. The frame work of the LT panel shall be connected to this earth busbar. Provisions shall be made for connection from earth busbar to the main earthing bar coming from the earth pit on both sides of the LT panel.

The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The GI strip shall be properly connected with earthing clamp and the clamp shall be ultimately bounded with the earth bar.

**LABELS**
Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

**NAME PLATE**
A name plate with panel designation in bold letter shall be fixed at top in the center of panel. A separate name plate giving feeder details shall be provided for each feeder module door.

Inside the feeder compartment the electrical component equipments accessories like switchgear, contactor, lamp, relays etc. shall suitably be identified by providing stickers.

Engraved name plates shall preferably be of 3 ply (red-white-red or black-white-black) lamicold sheet. However black engraved perplex sheet name plates shall also be applicable. Engraving shall be done with square groove cutters.

Name plate shall be fastened by counter sunk screws and not by adhesives.

**DANGER NOTICE PLATE**
The danger plate shall be affixed in a permanent manner on operating side of the panel.

The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.

The danger notice plate in general shall meet to requirements of local inspecting authorities.

Overall dimension of the danger notice plate shall be 200mm wide and 150mm inspecting authorities.

The danger notice plate shall be made from minimum 1.6mm thick and steel sheet and after due pre-treatment to the plate the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.

The letter, the figure, the conventional skull and bones shall etc. shall be positioned on the plate as per recommendations of IS 2551-1982.

The said letter, the figure and the sign of skull and bones be painted in single red colour as per IS: 5-1978.

The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the panel.

The danger notice plate with ISI certification mark.

**INTERNAL COMPONENTS:**
The LT panel shall be equipped complete with all type of required number of circuit breakers, switch disconnector fuse unit, contractor, relays, fuses, meters , instruments, indicating lamps push buttons equipment, fittings, busbar, cable boxes, cable glands etc. and all the necessary internal connections/ wiring as required and as indicated on relevant drawings. Components necessary for proper complete functioning of the LT panel but not indicated on the drawings/BOQ shall be supplied and installed on the LT panel.

All parts of the LT panel carrying current including the components connections, joints and instruments shall be capable of carrying their specified rated current continuously without temperature rise exceeding the acceptable values of the relevant specifications at any part of the LT panel.

All units of the same rating and specification shall be fully interchangeable.

**INSPECTIONS**
Each equipment should be inspected and witnessed by Engineer in Charge / PMC / or any officer.

The LT panel should be offered from inspection during the following stages as directed by Engineer-in-charge.
Before 7 tank process.
During powder coating.
Pre dispatch inspection

## PRE DISPATCH INSPECTION/TESTING

Prior to dispatch of the LT panel following tests shall be carried out.

Mechanical endurance test shall be carried out by closing and opening of all the MCB's, MCCB's

Overall voltage and insulation resistance test shall be carried out between phase and between phases to earth bus, keeping the isolating switch in ON position. Similar test shall be carried out keeping the isolating switch in closed position.

All the interlocks controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

Various electrical components and accessories of the LT Panel shall be tested for their proper functioning.

The LT panel shall be checked for rigid mounting earthing connections, proper rating and size of components, internal wiring etc.

All mechanical fasteners and electrical connections shall be checked and tightened before installation.

**COMPONENTS**

**A. GENERAL**

The type, Size and rating of the components shall be as indicated on the relevant drawings.

While selection of the capacity of the components resulting from the prevailing conditions like room temperature shall be allowed for the Thermal and magnetic trip rating shall be compensated for the ambient temperature.

The rating indicated on the drawings are rating anticipated at prevailing site condition.

**B.MINIATURE CIRCUIT BREAKER**

Miniature circuit breakers shall be quick make and break and break type conform to IS: 8825 (1996). The housing of MCB's shall be heat resistance and having high impact strength. The fault current of MCB's shall not be less than 10KA at 230 volts. The MCB's shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications.

The circuit breaker shall be of trip free pattern to prevent closing the breaker on a faulty current.

The MCB contact shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger relay for over current and short circuit protection.

The over load or short circuit devices shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCB's shall be tested and certified as per Indian standard, prior to installation.

**C.MOULDED CASE CIRCUIT BREAKER**

The MCCB should have quick make quick break with trip free operating mechanism. Operating handle of the MCCb shall be in front and clearly indicates ON/OFF/ TRIP positions.

The electrical contact of the circuit breaker shall be of high conducting non deteriorating silver alloy contacts.

The MCCBshall be provided with thermal/magnetic type bi-metal over load release and electro magnetic short circuit protection devise. All the releases shall operate on common trip busbar so that in case of operation of any one of the releases in any of the three phases. It will cut off all the three phases and thereby single phasing of the system is avoided.

The MCCB whenever called for in the BOQ shall provide an earth fault relay.

The electrical parameter of the MCCB shall be as per the descriptions given in the BOQ.

**E.Contactors:**

The contactors shall meet with the requirement of IS: 2959 and BS:775

The contactors shall have minimum making and breaking capacity in accordance with utilization category AC3 and shall be suitable for minimum class II intermittent duty.

If the Contactors forms part of a distribution board then a separate enclosure is not required but the installation of the Contactor shall be such that there should not be any possibility of making any accidental contact with live parts.

**F.LOAD MANAGER**

The load manager should be having facility to read voltage current harmonics power parameters. It should contain real time clock. The meter should be field programmable and to generate high/low profile for all power parameters with date and time also able to store previous period integrated data. The meter should have RS485 port for networking purpose. All the programming should be password protected.

**G.CURRENT TRANSFORMER**

Where ammeter is called for CT's shall be provided for current measuring as per requirement. Each phase shall be provided with separate CT of class I accuracy and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS 2705-1964 as amended up to date.

**H.INDICATING LAMP**

Indicating lamp shall be of LED type voltage rated and shall supplied complete with translucent covers to diffuse the lamp light.
Color shade for the indicating lamps shall be as below.
ON indicating lamp: Red
OFF indicating lamp: Green
Trip indicating lamp: Amber
PHASE indicating lamp: Red, Yellow and Blue

**17.28 Earthing**

All the non current carrying parts of electrical installation shall be earthed as per IS: 3043. All equipment, metal conduits, rising mains, cable metal armour, switch gear, distribution boards, meter. All other metal parts forming part of two separate and distinct conductors to earth electrodes. Earthing shall be in conformity with the provision of rules 32, 61, 62 & 68 of IER 1956.

17.29 The Tenderer shall be responsible for getting wiring approved from the local body, i.e. State Electricity Board / Electrical Inspector, as per requirement. The Inspection fee paid to the authority shall be reimbursed by BDA (on production of proof).

**17.30 Exterior Electrical Works**

**17.30.1 UG cabling and terminations**

11KV grade aluminium armoured PVC insulated and PVC sheathed UG cable shall be employed for the following works.

a) Street lighting.
b) Water pump installations.
c) Sewage pump installations.

The minimum size of cable to be employed for the work is 4Sqmm. The sizes of various cables to be used for various installations are indicated in the drawings and specifications.

**17.30.2 Cable Trench Preparation**

Excavation in all types of soil upto a depth of 750mm, dry river sand filling 75mm thick, laying of cables and laying of well burnt bricks over the cable to protect the same. The trench shall then be closed with excavated earth, the surplus earth shall be removed to a distant place.

**17.30.3 Cable Markers**

Cable markers shall be of good quality cast iron plates, round with engraving giving the voltage level of cable buried. The same shall be fixed to the ground by grouting the same with cement concrete. Cable markers shall be fixed at intervals and at turning points.

**17.30.4 Termination**

Termination shall be carried out with SIBG type glands and copper crimping lugs. Proper tool shall be employed for crimping the lugs.

### 17.30.5 Junction Boxes

Junction boxes shall be employed for terminating the street lighting cable to the street lighting poles. The same shall be fabricated out of 16 Swg CRCA sheets, painted with 2 coats of red oxide primer, and 2 coats of enamel paint of approved shade. The same shall house 1 no. 4 ways terminal block to terminate upto 4 Sqmm cable and 1 no. 16 A MCB. The junction box shall be fully weather proof with canopy and gasketed door with locking arrangements. The same shall mounting brackets to fix the same to the pole.

### 17.31 Telephone and Cable TV Routing

50 to 100mm dia PVC pipes shall be provided along the main road and sub road felicitating the DOT to draw the telephone cable and give connections to all houses and cable TV provider to lay the cable and give individual connections. The routing and layout of the PVC pipes shall be as per the drawings. The PVC pipes shall B class only. Necessary excavation for laying the pipes shall be carried out to a depth of 450mm. Inspection chambers shall be constructed at intervals and at junctions of size 600 X 600 X 450mm out of brick masonry with thickness of 230mm, cement plastering inside and top of chamber and covering the same with 150mm thick RCC slab provided with concealed lifting hooks.
Separate pipes shall be laid for cable TV and telephone.

### 17.32 Pump Control Panel

The panel shall be cubicle type, free standing, floor mounted with necessary bus bar chamber, cable alley, floor mounting channel and other accessories. This panel shall feed the water pumps and the sewage treatment plant and shall be located in the pump house. The bus bars shall be made out of adequate rating aluminium bars insulated with colour coded PVC sleeves, and supported on SMC supports. TPN switch fuse units, motor starters, etc. shall be mounted in separate cubicles fitted with hinged doors. The enclosure of panel shall conform to IP 42. The no. of feeders and other details shall be given in the respective item description in the schedule.
This specification covers the requirements of supply, installation, testing and commissioning of lightning protection system in conformity with the requirements of IS: 2309 consisting horizontal Grid termination, down conductors and earth stations.

The Advanced lightning protection system shall include:-

Air termination
Mechanical support
Low impedance insulated down conductor
A low impedance grounding system.

The lightning protection system shall have:-

An air terminal of the type designed to minimize corona emissions and optimize streamer inception when optimum pre-determined conditions are met.
It shall be mounted adequately rated for wind loading. Guy sets shall be provided as appropriate to local environmental conditions.

It shall be designed by a reputed company in the manufacture and development of advanced Lightning system components, of types, sizes and ratings and, who can produce support that their products have been in service for a long time and performance is in satisfactory condition and shall be installed strictly to the manufacturer's instructions.

**LIGHTNING PROTECTION SYSTEM**

**Air Terminal**

It shall respond dynamically to the appearance of a lightning down-leader, shall be designed to trigger in relation to the optimum pre-determined conditions for upward leader inception. The triggering conditions must dynamically adjust to reflect the down leader intensity, building height above ground and the other factors that effect the electric field intensification above the air terminal.

It shall incorporate a curved conductive surface spaced from a permanently grounded central finial. During triggering of the air terminal the curved conductive surface shall be temporarily grounded, thereby producing an increase in electric field directly above the air terminal.

The air termination shall be designed :-

With a range of optimal finial tip radii to match the different electric field conditions the terminal is subjected to at various installation heights above the ground level.

Arcing at the finial tip is not to be continuous and shall only occur during the process of lightning leader approach. Arcing shall not occur solely due to electro-static field created by the presence of charged overhead thunder clouds.

The materials used for the terminal shall be non-corroding in any type of environments. The centre grounded electrode tip shall not be less than 20mm diameter, the curved conductive surface shall be of a conductive material of thickness as defined in IEC61024.

The collection volume and attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.

The isolating material supporting the curved conductive surface from the centre grounded electrode shall be of glass/mineral reinforced polypropylene. This material used shall have the following properties, high impact strength, UV stabilized, high electrical dielectric, high comparative tracking index and operating heat capability up to 120°C continuous.

**DOWN CONDUCTORS**

Down-conductors consist of strips, braided cables or round sections.
Materials to be used: Bare or tin-plated copper (recommended), stainless steel or aluminum
Minimal cross-sectional area must be 50mm²
Down conductors shall be routed to the earth termination as direct as possible. Sharp bends and upward sections (40cm max with a 45° slope max are acceptable) are to be avoided.
Down conductors shall eventually be protected against the risk of impact by installing sleeves up to height of 2m above ground level
The down conductors shall be directly connected to the base of the air termination system and to the earth termination system by the mean of a test clamp.
If project structure is of structural steel frame construction, down conductors may be omitted and air terminals shall be connected to the structural steel frame around the perimeter of the structure. Connections to the steel frame shall be made with heavy duty bonding plates or with exothermic welds.

The materials shall be free from rust, scale and other electrical and mechanical defects. The size, materials and quantity shall be as specified.

Earthing conductors above ground shall be hot dip galvanized. If painted it shall be given two coats of approved anti-corrosive paint.

Test links in suitable enclosures shall be installed by the contractor at no extra cost for connection between each lightning conductor down conductor and earth electrode.

The scope of installation of lightning conductors on the roof of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods where necessary, laying, fastening/cleating/welding of the down-comers on the walls/columns of the building and connection to the test links above ground level, and upto earth station.

Lightning protection conductors shall not be connected to other general earthing conductors.

The lightning protection air termination rods and/or horizontal air termination conductors shall be fixed in such a way that they remain in their installed position even during adverse weather conditions.

The down conductors shall follow a direct path to earth. There shall not be any sharp, turns and kinks in the down conductors.

All joints in the down conductors shall be of welded/brazed type. All metallic structures within 2mtr vicinity of down conductors shall be bonded to the lightning protection system.

The lightning protection system shall not be in direct contact with the underground metallic service ducts, cables, cable conduits and metal enclosures of electrical equipment.

Lightning conductors shall not pass through or run inside G.I conduits.
Wherever required, if indicated in drawings, for fuel oil and other inflammable liquid storage tanks lightning and protection shall be provided with horizontal conductors strung between tall poles covering the entire areas.

**MODE OF TERMINATION AND JOINTS:.**

All joints in the horizontal roof conductors shall be of welded type. Where it is likely to damage the roof material like asbestos or sheet steel, riveted joints will be used.

Connection between roof conductors and down comers shall be of welded type. Where it is likely to damage the roof material like asbestos or sheet steel, riveted joints shall be used.

Individual pipe electrodes in turn shall be connected to station earthing system by welded joint at grid and bolted joint at electrodes.

Welding/brazing surfaces shall be cleaned and made free of all oxide films, grease, oil or any foreign material. However, the jointing surfaces should not be made too smooth/highly polished to prevent the jointing metal from flowing always.

The items to be welded/brazed shall not be clamped/tied tightly (at the same time clearance should not be excessive), to allow the flux/alloy to run freely through the joint and alloy itself with the surface to be joined together.

All brazing shall be done oxy-acetylene torch flame.

All welded connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling hall not be allowed.

**LAYING:**
Precautions shall be taken such as providing an up stand and using PVC or glass filled nylon clamps, so that contact with cement mortar is avoided. When the roof conductors are closer to beams less than 2M. Bonding between the beam columns and down comer shall be provided to prevent side flashing.

Pipes carrying hazardous substances shall be protected by suitable steel wire or lightning conductors at a height to provide total protection against lightning. Joint in these pipe lines shall be bonded by a copper flexible with copper clamps on either side of the joints. Pipe line shall be earthed at both ends. Either isolation shall be provided by keeping the lightning conductor 2M away or they shall be bonded if they are close to each other.

Routing of lightning conductors down comer shall be done in such a way that they do not run parallel with power control and instrumentation cable. They shall be taken by crossing at 90DEG. If parallel routing is unavoidable minimum distance of 2 M shall be ensured.

**JOINTS BONDING**
The system shall have preferably no joints and they shall be made mechanically and electrically strong and effective. Bolted joints should only be used on test points or on bonds to as existing metal. Generally jointing/connections/installations shall be as in earthing system.

# TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING & PROTECTION SYSTEM

## 18.0 FIRE FIGHTING SYSTEM

The building has to follow NBC Part Table 23, December 2005. It is been classified under Group C

Following are the requirements:

Fire Extinguisher

Hose Reel

Wet Riser

Down comer

Yard Hydrant

Automatic Sprinkler System

Manually Operated Electric Fire Alarm System

Automatic Detection & Alarm System

Underground static water storage tank

Terrace tank

Pump near underground static water storage tank

Pump near Terrace level

Jockey, Electric & Diesel pump of required capacity to be procured and installed depending on the height of the building.

## 18.1 APPLICABLE CODES AND STANDARDS:

The work shall be carried out in accordance with the regulations of local bodies, if any, and the following specifications and codes which may govern the requirements of the system.

1.IS 1641 : 1988 Code of practice for fire safety of building ( general), general principle fire grading & classification ( first revision ).

2.IS 1646 : 1997 Code of practice for fire safety of building ( general ) : Electrical installation ( second revision ).

3. IS 9457 : 1980 Safety colours and safety signs.
4. IS 12349 : 1988 Fire protection – safety sign.
5. IS 12407 : 1988 Graphic symbols for fire protection plan.
6. IS 2189 : 1999 Code of practice for selection, installation & maintenance of alarm system ( second revision ).
7. IS 884 : 1985 Specification for first-aid hose reel for firefighting ( first revision )

| | |
|---|---|
| 8. IS 902 : 1992 | Specification for suction hose couplings for firefighting purposes( third revision ). |
| 9. IS 903 : 1993 | Specification for suction hose delivery coupling, branch pipe, nozzles & nozzle spanner ( fourth revision ). |
| 10. IS 15683 : 2000 | Specification for fire extinguisher, carbon-do-oxide type ( portable & trolley mounted ) ( third revision ). |
| 11. IS 5290 : 1993 | Specification for landing valve ( third revision ). |
| 12. IS 5612 | Specification for hose clamps and hose bandages for fire brigade use. |
| 13. IS 9583 : 1981 | Emergency lighting units. |

**TECHNICAL SPECIFICATIONS FOR FIRE ALARM SYSTEM &PUBLIC ADDRESS SYSTEM:**

The scope of work under this head shall include designing supplying and installing of analog addressable fire alarm system. The work under the system shall consists of furnishing all material equipments and appliances on labour necessary to install the system complete with sounders, manual call point, fire alarm panel etc.

It shall include laying of cables necessary for installation of the system

All wiring/cabling shall be done using 2CX1.5 sq mm (2pair) 1100 V FRLS PVC insulated unarmored copper cable

Design basis
Design standards: As per national building code 2005
Fire alarm system: Addressable automatic fire alarm system.

**MANUAL CALL POINT:**

The manual call point shall be addressable type with input module to define the station the over all size of the MCP shall not exceed 100mX100mmX60mm. It shall consist of an enclosure with a capacitive glass pane and it shall incorporate and addressable communication module. Breaking the panel fiber glass shall initiate an alarm. No secondary action shall be required by the operator

The Manual call point shall incorporate a plastic laminated safety glass which will not produce sharp edges when broken there by protecting the operator from injury.

**HOOTERS/SOUNDERS:**

The hooters shall be addressable loop powered with high sound output and shall be designed to simplify installation including terminals for both in and out going cables and an earth termination for cables screen. Electronic components in the sounder shall be protected by a cover to prevent damage during installation.

Annunciation (hooter alarm) facility shall also be inbuilt into the FACP the panel being able to initiate alarm signal for any particular zone/loop.

The system shall be fully supervised for all fault condition with distinctive alarm operated for fault and fire conditions. Test push buttons software features shall be provided to test the electronic circuits and detectors conditions.

**INSTALLATION:**

Installation shall be accordance with the local and state codes and as recommended by the major equipment manufacturer.

All casing and capping/ conduits elbows tees junction boxes casing and capping conduit supports and hangers shall be concealed in finished areas an. Smoke detectors shall not be installed prior to the system programming and test period. If construction is going on during this period measures shall be taken to protect smoke detectors from contamination and physical damage.

All fire detection and alarm system devices control panels and remote annunciator shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

**FINAL INSPECTION:**
At the final inspection the contractor shall arrange a factory trained representative of the manufacturer of the major equipment at site to demonstrate that the systems functions properly in every respect.

**INSTRUCTION:**
Provide instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and function shall be provided.

The contractor and/or the systems manufacturers representative shall provide a typewritten “sequence of operation”.

**EXIT BOARDS:**
The exit boards of 13.25inch/9inch size to be procured and installed by contractor with labeling written as EXIT in English and Hindi. The exit board to be provided with LED light/CFL light.

**MAINTAINENCE:**
Detailed operation and maintenance manual (3sets) shall be supplied.